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# SELECTED WATER RESOURCES ABSTRACTS

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# SELECTED
# WATER RESOURCES ABSTRACTS

A monthly publication of the Geological Survey
U.S. Department of the Interior

**VOLUME 19, NUMBER 1**
JANUARY 1986

W86-00001 -- W86-00307

The Secretary of the Interior has determined that the publication of the periodical is necessary in the transaction of the public business required by law of this Department.

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering the wisest use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to assure that their development is in the best interests of all our people. The Department also has a major responsibility for American Indian reservation communities and for people who live in Island Territories under U.S. administration.

# PREFACE

**Selected Water Resources Abstracts,** a monthly journal, includes abstracts of current and earlier pertinent monographs, journal articles, reports, and other publication formats. These documents cover water resources as treated in the life, physical, and social sciences and the related engineering and legal aspects of the characteristics, supply condition, conservation, control, use, or management of water resources. Each abstract includes a full bibliographic citation and a set of descriptors which are listed in the **Water Resources Thesaurus.** The abstract entries are classified into 10 fields and 60 groups similar to the water resources research categories established by the Committee on Water Resources Research of the then Federal Council for Science and Technology.

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Water Resources Scientific
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# SELECTED WATER RESOURCES ABSTRACTS

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### 2A. General

**SPATIALLY VARYING RAINFALL AND FLOODRISK ANALYSIS,**
Massachusetts Inst. of Tech., Cambridge.
For primary bibliographic entry see Field 2E.
W86-00012

**NONLINEAR TIME-VARIANT CONSTRAINED MODEL FOR RAINFALL-RUNOFF,**
Arkansas Univ., Fayetteville. Engineering Experiment Station.
B. Datta, and D. P. Lettenmaier.
Journal of Hydrology, Vol. 77, p 1-18, 1985. 3 Fig, 7 Tab, 11 Ref. State of Washington Water Research Center project C-00234.

Descriptors: *Rainfall-runoff relationships, *Model studies, *Constrained linear system model, *Nonlinear models, Hydrologic models, Precipitation, Runoff, Mathematical studies, Statistical analysis, Hydrologic models.

Models of the rainfall-runoff process can be segregated into two classes: those based on input-output (black box) techniques, and those based, directly or indirectly, on the laws of physics. Both approaches have limitations and advantages. A combined model was developed which incorporates an approximated description of the physical process to estimate effective precipitation and uses the input-output estimation procedure of the constrained linear system (CLS) model to relate effective precipitation to runoff. Certain problems of poor calibration and prediction encountered with the CLS model were significantly reduced by using estimated effective precipitation in place of actual precipitation. Use of the precipitation preprocessor with the CLS runoff model effectively incorporates nonlinear and time-variant dynamics without the necessity for multiple-parameter vectors and antecedent precipitation thresholds required by the original version of CLS. Additional refinements, including time variability of some of the parameters, can easily be accommodated in the new formulation. (Author's abstract)
W86-00022

**VARIOGRAM IDENTIFICATION BY THE MEAN-SQUARED INTERPOLATION ERROR METHOD WITH APPLICATION TO HYDROLOGIC FIELDS,**
Centre National de la Recherche Scientifique, Grenoble (France). Inst. de Mecanique de Grenoble.
T. Lebel, and G. Bastin.
Journal of Hydrology, Vol. 77, p 31-56, 1985. 10 Fig, 10 Tab, 23 Ref.

Descriptors: *Variograms, *Mean squared interpolation error method, *Interpolations, *Hydrologic models, Model studies, Hydrologic data, Interpolation errror, Statistical analysis.

Real-life applications of BLU (best linear unbiased) interpolation in random fields, require, in most cases, a preliminary identification of a parametric model for the variogram of the field of interest. The variogram identification can be performed by minimizing a functional of a set of observed interpolation errors; the 'mean squared interpolation error' (MSIE) method is such a method for variogram identification. A theoretical analysis of the MSIE method was performed under the realistic assumption that the parametric variogram model is only an approximation of the true-field variogram. A general asymptotic property was demonstrated which does not require any specific assumption on the probability density of the field. In a piezometric field application, the variogram model was a basic tool for the contour mapping of the water level. The MSIE criterion is an efficient tool to discriminate between alternative variogram models and, in this case with scarce data, the models obtained with the MSIE method can differ substantially from those derived from the experimental variogram: a theoretical analysis of the robustness of the various identification methods with small data sets would be very useful. In a rainfall field application, the variogram model was needed to calculate mean areal rainfall variances and mean areal GRADEX. A global climatological variogram was identified: a very large data set was available and the best model was very close to the experimental variogram. An interesting cross-validation result is that the parameter estimates obtained from two subsamples of the complete data set are very close. (Collier-IVI)
W86-00024

**REGIONAL FREQUENCY ANALYSIS OF MULTIYEAR DROUGHTS USING WATERSHED AND CLIMATIC INFORMATION,**
Montgomery (James M.), Inc., Salt Lake City, UT.
E. G. Paulson, Jr., J. Sadeghipour, and J. A. Dracup.
Journal of Hydrology, Vol. 77, p 57-76, 1985. 1 Fig, 4 Tab, 31 Ref. NSF grant 77-11137 and University of California Water Resources Center grant W-615.

Descriptors: *Frequency analysis, *Droughts, *Climatology, *Statistical analysis, *Central Valley, *California, Meteorological data, Multiple regression analysis, Regression analysis, Streamflow, Data interpretation.

A regional frequency analysis of hydrologic multiyear droughts was performed using multiple linear regression to estimate characteristics of drought severity, magnitude and duration from indices of watershed geomorphology, and climate. Thirteen characteristics of drought severity, magnitude and duration were used as dependent variables; eleven indices of watershed geomorphology and meteorology were used as independent variables. Reasonable estimation accuracy was obtained utilizing Central Valley of California, U.S.A., streamflow data (mean standard errors between 14% and 41%). The proposed regression relations are primarily statistical models, and are not necessarily reliable indicators of cause-and-effect physical relationships. (Author's abstract)
W86-00025

**STATISTICAL CHOICE OF EXTREMAL MODELS FOR COMPLETE AND CENSORED DATA,**
Agricultural Univ., Wageningen (Netherlands). Dept. of Mathematics.
M. A. J. Van Montfort, and M. I. Gomes.
Journal of Hydrology, Vol. 77, p 77-87, 1985. 3 Fig, 2 Tab, 10 Ref, 1 Append.

Descriptors: *Statistical analysis, *Mathematical studies, *Extremal models, *Censored data, Data interpretation, Hydrologic data, Model studies, Probability distribution.

Often one of the three well-known limiting distributions of univariate extremes, e.g. maxima of riverflow or precipitation, is successfully fitted to the data, and the estimated values corresponding to given return periods calculated. Within the framework of the general extreme-value distribution (GEV, with shape parameter Theta), which combines the Frechet (Theta $<$ 0), Gumben (Theta $=$ 0) and Weibull types (Theta $>$ 0), the power functions of some statistics for rejecting the Gumbel distribution (Theta $=$ 0) were compared. Often in checking the suitability of a distribution, a goodness of fit test is used involving the whole range of the distribution while the valid interest is in one tail only. The interest in whether Theta deviates from zero arises when one is concerned with the value of a variate corresponding to a return period nearly equal to the length of the sample. The conditions for adequate behavior in the right-hand tail are not always the same as for the left-hand tail, and lack of fit in the left-hand tail should not influence inferences concerning the right-hand tail. It is necessary to consider the loss in power of tests for rejecting Theta $=$ 0 in left-hand censored samples, where the observations with a rank lower than a specified value are missing. (Collier-IVI)
W86-00026

**DISCRETE-TIME LINEAR CASCADE UNDER TIME AVERAGING,**
National Hydrology Research Inst., Ottawa (Ontario).
V. Klemes, I. Klemes, and J. E. Glynn.
Journal of Hydrology, Vol. 77, p 107-123, 1985. 5 Fig, 13 Ref, 1 Append.

Descriptors: *Streamflow, *Model studies, *Linear cascades, *River basins, Stochastic process, Basin storage, Hydrologic models.

A cascade of linear reservoirs defined in discrete time has been suggested as a lumped conceptual model for a river basin for the case when the streamflow (basin output) at a control point is represented by an autoregressive time series in which the (uncorrelated and identically distributed) random component represents the time series of net basin input, i.e. roughly speaking, of precipitation minus evapotranspiration. An attempt has been made to find out whether the relationship between the total gravity storage of a basin and its runoff, whose empirical determination is within the reach of hydrologic analysis, can be used to test the assumption of linearity of a discrete-time stochastic hydrologic model. A theoretical investigation of the relationship between the total storage in a discrete-time linear cascade and the output at time t, and between averages of these two variables over T consecutive times, is examined. (Baker-IVI)
W86-00028

**COMPARISON OF TWO DAILY STREAMFLOW SIMULATION MODELS OF AN ALPINE WATERSHED,**
Colorado Univ. at Boulder. Dept. of Civil, Environmental, and Architectural Engineering.
For primary bibliographic entry see Field 2E.
W86-00033

**DETERMINATION OF RESISTANCE PARAMETERS OF PLUVIO-NIVO-GLACIAL ALPINE SYSTEMS BY MATHEMATICAL MODELING OF RUNOFF,**
Vrije Univ., Amsterdam (Netherlands). Dept. of Hydrogeology and Geographical Hydrology.
For primary bibliographic entry see Field 2E.
W86-00034

**MULTIPLE NONLINEAR STATISTICAL MODELS FOR RUNOFF SIMULATION AND PREDICTION,**
Alcoa of Australia Ltd., Applecross.
For primary bibliographic entry see Field 2E.
W86-00035

**EFFECTS OF INCORRECTLY REMOVED PERIODICITY IN PARAMETERS ON STOCHASTIC DEPENDENCE,**
George Washington Univ., Washington, DC. International Water Resources Inst.
V. Yevjevich, and J. T. B. Obeysekera.
Water Resources Research, Vol. 21, No. 5, p 685-690, May, 1985. 6 Fig, 2 Tab, 7 Ref. NSF grant CEE-7916817 and CEE 84-05289/85-41631.

Descriptors: *Hydrologic time series, *Stochastic hydrology, *Time series analysis, Mathematical studies, Seasonal variation, Model studies, Harmonics.

Most hydrologic time series are periodic-stochastic processes in which the stochastic component is mixed with periodic parameters. Modeling of seasonal hydrologic time series often requires the identification of periodic functions of its basic parameters such as the mean, standard deviation, and autocorrelation coefficients. The consequences of incorrect estimation of harmonics on dependence models of the stochastic component are investigated. For each underestimated harmonic in the periodic mean the stochastic nonstationary dependence models will have four additional terms, with four coefficients to be estimated instead of only two in the harmonic. For each overestimated harmonic in the mean two additional coefficients must be esti-

mated, with a slight effect on estimated coefficients of dependence models and a practically negligible effect on model identification. If one has to select between underestimation or overestimation, the penalty is smaller for the case of overestimation of harmonics in the mean. The identification of the dependence model of the stochastic component is not significantly affected either by underestimation or overestimation. A neglect of periodicity in autocorrelation coefficients leads to inferences of incorrect stationary stochastic dependence models, while in reality they are nonstationary. (Baker-IVI)
W86-00075

**SYNTHESIS OF RADAR RAINFALL DATA,**
National Weather Service, Silver Spring, MD. Hydrologic Research Lab.
W. F. Krajewski, and K. P. Georgakakos.
Water Resources Research, Vol. 21, No. 5, p 764-768, May 1985. 1 Fig, 2 Tab, 14 Ref.

Descriptors: *Rainfall, *Radar, Rainfall-runoff relationships, Model studies, Hydrologic models, Simulation, Rain gages, Mathematical studies.

Procedures are being developed to merge radar and rain gage observations, to obtain the best estimate of the rainfall field, taking advantage of the spatial detail that the radar gives and of the high point accuracy of the gages. Reliable synthesis of radar-rainfall fields can be useful for validation as an alternative to field experiments. A method of generating synthetic radar-rainfall data is described. The data are generated by imposing random noise on a given, high-quality radar-rainfall field. Certain conditions are imposed on the resultant rainfall field so that the noise parameters are prespecified. In that way nonstationary nonergodic fields can be simulated. Since the original and the observation (original and noise) fields are known, the method can be used in the validation procedures of various hydrologic models (radar and rain gage data merging, mean areal precipitation estimation, rainfall-runoff). The example given shows that the accuracy of the preservation of the required statistics is very good, especially for realistic values of the variance measure, even for a relatively small number of realizations. The method proposed is flexible in that one can generate fields with a wide range of second order statistics from one high quality radar field. When the technique is used to investigate radar and rain gage data merging, a procedure is required to synthesize the gage data. (Baker-IVI)
W86-00084

**ATTEMPT TO IMPLEMENT SWMM IN TUNISIA,**
Lund Univ. (Sweden).
For primary bibliographic entry see Field 6A.
W86-00087

**DATA MANAGEMENT FOR CONTINUOUS HYDROLOGIC SIMULATION,**
North Carolina Univ. at Charlotte. Dept. of Urban and Environmental Engineering.
J. S. Wu.
In: Proceedings of Stormwater and Water Quality and Model User Group Meeting, January 27-28, 1983, University of Florida, Gainesville. p 161-176, 11 Fig, 6 Tab, 4 Ref.

Descriptors: *Rainfall-runoff relationships, *Rainfall, *Runoff, *Agricultural watersheds, *Hydrologic models, *Model studies, *Regression analysis, *Watershed management, *Agricultural runoff, Evapotranspiration, Models, Watersheds, Groundwater recharge, Soil water, Simulation analysis.

The U.S. EPA's Agricultural Runoff Model (ARM) was applied to the continuous hydrologic simulation of one of the agricultural watersheds of the Chowan River Basin in North Carolina. Regression analysis was employed to generate missing rainfall-runoff data required for calibration of the ARM model. Monthly rainfall, evapotranspiration and runoff data served as model input data and output data consisted of monthly rainfall, runoff, evapotranspiration, soil moisture changes, and groundwater recharge. Model simulations agreed well with per storm comparisons and recorded hydrographs and demonstrated the successful calibration for the Cutawhiskie site of the watershed. With a good data-base for calibration and verification, the continuous hydrological simulation model can be a useful tool for evaluating the effectiveness of watershed management practices over an extended period of time.
W86-00093

**SNOWMELT INDUCED URBAN RUNOFF IN NORTHERN SWEDEN,**
McMaster Univ., Hamilton (Ontario).
For primary bibliographic entry see Field 2C.
W86-00097

**STORM SEWER OPTIMUM DESIGN,**
For primary bibliographic entry see Field 8B.
W86-00100

**ATCHAFALAYA RIVER DELTA; REPORT 8: NUMERICAL MODELING OF HURRICANE-INDUCED STORM SURGE,**
Coastal Engineering Research Center, Vicksburg, MS.
B. A. Ebersole.
Technical Report HL-82-15, January 1985. Report 8 of a Series. 94 p, 61 Fig, 6 Tab, 21 Ref.

Descriptors: *Mathemetical models, *Simulation analysis, *Hydrodynamics, *Hurricanes, *Tidal hydraulics, Models, Model studies, Numerical analysis, Mathematical studies, Bays, Tides, Storm surges, Storm tides, Hydraulic models.

The U.S. Army Engineer Waterways Experiment Station Implicit Flooding Model (WIFM) was applied to the Atchafalaya River Delta Project. This numerical model was used to simulate the hydrodynamics within the bay resulting from astronomical and/or meteorological forcing. The WIFM model solves finite difference approximations of the governing equations on a grid mesh of fixed spatial extent for a finite number of constant time increments, utilizing an alternating-direction, implicit solution scheme. The accuracy of the model was verified using a comparison of observed and simulated water elevations. Comparisons showed that the model can accurately simulate the response of the system to the astronomical tide and hurricanes. In the case of tides alone, errors were very small. However, in the storm surge applications, errors were larger. Using the verified model, a set of hypothetical storms was simulated. Dynamical characteristics of these storms reflect hurricanes that have occurred in this area in the past. Hydrodynamics from these storms will be used in other tasks to investigate the response of the Atchafalaya River delta growth to extreme meteorological events.
W86-00164

**HYDROLOGICAL YEARBOOK: 1980.**
Reeve (Douglas) and Associates, Toronto (Ontario).
Publications of the Water Research Institute, No. 53, 1983. 174 p, 2 Maps, 7 Append.

Descriptors: *Watersheds, *Hydrologic data collections, *Precipitation, *Runoff, *Floods, Finland, Groundwater, Rivers, Water level, Ice, Snow cover, Water temperature, Temperature, Hydrographs, Lakes, Frost, Water storage.

Hydrological statistics for Finland are reported. At the beginning of 1980 water storage was average for the season. Toward the end of the year storage was exceptionally low in the north and plentiful in the south. A 100-yr flood for autumn occured in the Aurajoki in late November; other rivers flooded during this time. At the end of the year record snow cover, up to 150 mm of water in some places, was on the ground. Tables and hydrographs include data on water levels and stages, discharge, maps of hydrological basins, runoff, areal precipitation and water equivalent of snow cover, evaporation, surface temperature of open waters, dates of freeze-up and ice breakup, ice cover thickness, ground frost, and groundwater.
W86-00182

**HYDROLOGICAL SIMULATION PROGRAM--FORTRAN (HSPF): USERS MANUAL FOR RELEASE 8.0,**
University of the Pacific, Stockton, CA.
R. C. Johanson, J. C. Imhoff, J. L. Kittle, and A. S. Donigan.
EPA-600/3-84-006, June 1984. Environmental Protection Agency, Athens, GA. 767 p, 138 p, 49 Ref, 5 Append. Contract/Grant No. 68-01-6207.

Descriptors: *Hydrologic models, *Model studies, *Computer programs, Streams, Lakes, Hydrological Simulation Program--FORTRAN, Water quality, Water supply, Rainfall-runoff relationships, Data processing, Fortran.

The Hydrological Simulation Program--FORTRAN (HSPF) is a set of computer codes that can simulate the hydrologic, and associated water quality, processes on pervious and impervious land surfaces and in streams and well mixed impoundments. The manual discusses the modular structure of the system, the principles of structured programming technology and the use of these principles in the construction of the HSPF software. In addition to a pictorial representation of how each of the 500 subprograms fits into the system, the manual presents a detailed discussion of the algorithms used to simulate various water quality and quantity processes. Data useful to those who need to install, maintain, or alter the system or who wish to examine its structure in greater detail also are presented. (Author)
W86-00199

## 2B. Precipitation

**STATISTICAL ANALYSIS OF PRECIPITATION FREQUENCY IN THE CONTERMINOUS UNITED STATES, INCLUDING COMPARISONS WITH PRECIPITATION TOTALS,**
Midwest Research Inst., Kansas City, MO.
P. J. Englehart, and A. V. Douglas.
Journal of Climate and Applied Meteorology, Vol. 24, No. 4, p 350-362, April, 1985. 7 Fig, 5 Tab, 32 Ref. NSF grant ATM-8219370.

Descriptors: *Statistical analysis, *Total precipitation, *Precipitation frequency, *Weather data collections, Data interpretation, Spatial distribution, Temporal distribution.

An alternative measure of time-aggregated precipitation for use in short-term climate studies was developed; this measure, precipitation frequency, is defined as the number of days per month or season with total amounts > or = 2.54 mm (0.10 inch). Newly created data sets for the period 1951-80 were used as a basis for describing large-scale spatial and temporal features of precipitation frequency for the mainland United States. Comparisons between precipitation frequency and the conventional statistic, total precipitation, indicate that frequency is more normally distributed and more spatially coherent than total precipitation. Factor analysis and an orthogonal rotation to the varimax criterion identify synoptic-scale, spatially coherent regions of precipitation frequency. The regions are generally consistent with previously documented cyclone trajectories. (Author's abstract)
W86-00020

**SOIL MOISTURE CONTENT: STATISTICAL ESTIMATION OF ITS PROBABILITY DISTRIBUTION,**
Kozponti Meteorologiai Intezet, Budapest (Hungary).
For primary bibliographic entry see Field 2G.
W86-00021

**ANALYSIS OF THE EFFECTS OF OROGRAPHY ON SURFACE RAINFALL BY A PARAMETERIZED NUMERICAL MODEL,**
Consiglio Nazionale delle Ricerche, Perugia (Italy). Ist. di Ricerca per la Protezione Idrogeologica nell' Italia Centrale.

C. Corradini.
Journal of Hydrology, Vol. 77, p 19-30, 1985. 3 Fig, 1 Tab, 12 Ref.

Descriptors: *Orography, *Rainfall, *Model studies, *Geography, *Upper Tiber River basin, *Italy, Spatial distribution, Hydrologic models, Data interpretation, Orographic precipitation, Precipitation.

A numerical model was formulated for estimating the spatial distribution of rainfall on the meso-local scale; the model considers widespread rainfall not influenced by convective processes. The observed rainfall on the soil surface unaffected by orographically produced contributions and meteorological parameters on the large scale are used as inputs to the model. The model is then used for computing the spatial distribution of rainfall incorporating the orographic effects in a parameterized form. The model was applied to four rainfall events over an area of the Upper Tiber River basin (central Italy); the results compare reasonably well with the observations in each event. The error in computing mean areal rainfall ranges in magnitude from 1% to 15%; for each event at least 75% of the point-estimates has an error of less than + or - 30%. (Author's abstract)
W86-00023

INTERCEPTION STORAGE CAPACITIES OF TROPICAL RAINFOREST CANOPY TREES,
Boston Coll., Chestnut Hill, MA. Dept. of Geology and Geophysics.
For primary bibliographic entry see Field 2I.
W86-00037

ESTIMATION OF MISSING VALUES IN MONTHLY RAINFALL SERIES,
Florida Univ., Gainesville. Dept. of Environmental Engineering Sciences.
E. Foufoula-Georgiou.
In: Proceedings of Stormwater and Water Quality Model User Group Meeting, January 27-28, 1983, University of Florida, Gainesville. p 177-191, 3 Fig, 6 Tab, 19 Ref.

Descriptors: *Statistical analysis, *Time series analysis, *Statistical models, *Model studies, *Mathematical studies, *Stochastic process, *Stochastic hydrology, *Model testing, Statistical methods, Theoretical analysis, Models, Mathematical models.

Three methods for infilling missing values in hydrological time series are discussed. The first method utilizes regional-statistical data by the mean value method, the reciprocal distance method, the normal ratio method or the modified weighted average method. The second method uses a univariate stochastic (ARMA) model which describes the time correlation of the series. The third technique relies on a multivariate stochastic (ARMA) model which describes the time and space correlation of the series. An algorithm for the recursive estimation of the missing values by a parallel updating of the univariate or multivariate stochastic ARMA models is proposed and demonstrated. All of the infilling methods were applied to a case study using 55 yr of monthly rainfall data from four south Florida stations. Results showed that all the the traditional estimation techniques give unbiased (overall and monthly) means and correlation coefficients at the 5% significance level for as high as 20% missing values. If an ARMA model is to be used in an incomplete series to construct forecasts, then the estimation of missing values and parameters of the model by the proposed recursive algorithm is recommended.
W86-00094

AREAL INTENSITY-DURATION-FREQUENCY CURVES: A POSSIBLE WAY OF IMPROVING THE RAINFALL INPUT,
Lund Univ. (Sweden). Dept. of Water Resources Engineering.
J. Niemczynowicz.
In: Proceedings of Stormwater and Water Quality Model User Group Meeting, January 27-28, 1983, University of Florida, Gainesville. p 192-201, 6 Fig, 1 Tab, 17 Ref.

Descriptors: *Areal precipitation, *Rainfall intensity, *Graphical methods, *Precipitation intensity, *Depth-area-duration analysis, *Frequency analysis, *Regional analysis, *Mathematical studies, Precipitation, Storms, Rainfall, Runoff, Rain gauges, Urban hydrology, Data interpretation.

Point and areal intensity-duration-frequency (i-d-f) curves for the city of Lund, Sweden were generated using data from a 25 sq km area raingauge network with 12 gauges installed in 1978. The gauges were of the automatic tipping-bucket type and were governed by the same clock to achieve absolute time synchronization. Since the main goal of this study was to compare the point rainfall statistics with the areal rainfall statistics for short term rainfalls, all events with low intensity were taken out of the data base. To extrapolate rainfall data from point to areal values, specific areas were associated to all gauges. Analysis of results showed that areal i-d-f relationships gave different rainfall values then point i-d-f relationships. Areal rainfall intensity values were lower for all durations and return periods. If point i-d-f curves are used for deriving design storms, the error in average rainfall intensity and rainfall volume will be introduced for simulation of runoff from real catchments. The magnitude of error depends on duration, return period, and catchment size. The most significant differences between point and areal rainfall values can be found for short durations and long return periods. The areal i-d-f curves gave more realistic design storms than those derived from point i-d-f curves.
W86-00095

OUTLINE OF SEVERE LOCAL STORMS WITH THE MORPHOLOGY OF ASSOCIATED RADAR ECHOES,
National Weather Service Training Center, Kansas City, MO.
R. Grebe.
Available from the National Technical Information Service, Springfield, VA 22161, as PB83-114454. National Oceanic and Atmospheric Administration, Rockville, MD. June 1982. NOAA Technical Memorandum NWS TC 1. 80 p. 56 Fig, 64 Ref, 9 Append.

Descriptors: *Radar, *Storms, *Thunderstorms, *Weather forecasting, *Storm warnings, Storms, Velocity derived fields, Doppler radar.

This outline focuses on the interpretation of conventional radar data for the identification of severe local storms. The technique of improving warnings is dependent upon the ability to identify the potential before the event occurs. The primary tools presently available include trained spotters, and satellite and radar observations. Most of the radar research work in severe local storms accomplished in the 1970's was done with Doppler radar. Doppler is conventional radar plus 'more'. The 'more', velocity derived fields, has increased our understanding of storm structure and the morphology of precipitation related echoes. It will be to the advantage of the operational community using conventional radar to apply the technology of Doppler in a practical way. Documented radar signatures associated with severe local storms dating back to the 1950's have been included. Some of them are in apparent conflict with contemporary storm models. The rationale for including them is (1) these signatures can still be operationally useful as alerting features and (2) today's storm models are likely to change as our understanding of the physical processes that produces them increases. As such, this outline is not intended to conflict with National or Regional Weather Service policy regarding the use of radar signatures in issuing severe thunderstorm or tornado warnings. The test of a radar signature leading to the identification of a severe local storm occurs in the field under the stress of making day-to-day warning decisions. No signature or combination of signatures guarantees the existence of a severe storm any more than a numerical model will produce a perfect weather forecast. In both cases, a probability is assigned to the occurrence of the event and a decision is based on that probability.
W86-00146

MARINE WEATHER OF THE INLAND WATERS OF WESTERN WASHINGTON,
National Oceanic and Atmospheric Administration, Seattle, WA. Pacific Marine Environmental Lab.
J. E. Overland, and B. A. Walter.
NOAA Technical Memorandum ERL PMEL-44, January 1983. 62 p, 30 Fig, 7 Tab, 42 Ref.

Descriptors: *Precipitation, *Meteorology, *Climatic data, *Marine climates, *Weather patterns, Washington, Puget Sound, Pacific Ocean, Wind, Olympic Mountains, Topography, Temperature, Hydrology, Hood Canal bridge.

The mid-latitude, west coast marine climate of western Washington is typified in summer by high sea-level pressure as part of the North Pacific weather pattern and in winter by a sequence of storms which originate to the west. Mean and extreme temperatures are moderated by the proximity of the Pacific Ocean and Puget Sound, resulting in a mean temperature of 4 degrees C in January and 17 degrees C in August at Seattle. Local variations in precipitation and wind are influenced by both large-scale weather patterns and the region's topography. Fifty percent of the annual precipitation for most of the inland region falls in the four months from November through February, and less than five percent falls in July and August; the driest region is to the northeast of the Olympic Mountains. Over the inland waters, the winds flow from high to low sea-level pressure in the direction of the local channels. Recent studies by the University of Washington and the Pacific Marine Environmental Laboratory on the Puget Sound convergence zone, sea and valley breeze, precipitation patterns and local wind patterns are summarized. The storm which resulted in destruction of the Hood Canal Bridge has shown that the presence of the Olympic Mountains can induce a regional low-pressure system in their lee which can result in strong surface winds over the inland waters. (Author)
W86-00165

SCPP DATA COLLECTION AND ANALYSIS FOR THE PERIOD 1 SEPTEMBER 1981 THROUGH 31 AUGUST 1982,
Atmospherics, Inc., Fresno, CA..
M. Solak, T. Henderson, R. Allen, S. Barnes, and M. Henderson.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-116707. Interim Progress Report Number Four, August 27, 1982. 182 p, 62 Fig, 13 Tab, Append. Contract/Grant No. 9-07-85-V0020.

Descriptors: *Precipitation, *Network design, *Cloud physics, *Ice formation, *Weather modification, Sierra Nevada, Orographic precipitation, Data collections, Supercooling, Cooling, Data acquisition, Meteorological data collection, Data processing, Gages, Snow.

Data collection and analysis tasks performed for the Sierra Cooperative Pilot Project are described. The Sierra project is concerned with the physical processes of precipitation formation during the winter over a portion of the Sierra Range in California, artificial enhancement of winter precipitation, and weather resources management to improve California's water resources in this mountain range. Tasks performed were installation, operation, and maintenance of, and data collection and analysis from, a network of precipitation gages as well as ground-based instrumentation for detection of supercooled liquid water.
W86-00216

GROUND-BASE SNOW AND ICE CRYSTAL OBSERVATION SYSTEM USED IN SIERRA NEVADA WINTER OROGRAPHIC STORMS,
Atmospherics, Inc., Fresno, CA..
M. Henderson, M. Henderson, S. Pinion, E. Pinion, and M. Solak.
Technical Report AISCP-841, April 1984. 34 p, 3

Fig, 5 Tab, 38 Photos, 9 Ref. Contract/Grant No. 0-07-85-V0020.

Descriptors: *Precipitation, *Weather modification, *Snow, *Ice, Orographic precipitation, Photography, Cloud physics, Cloud seeding, Artificial precipitation, Sierra Nevada, California, Sierra Cooperative Pilot Project, Sampling, Data acquisition, Crystals.

This report describes the use of a ground based photographic snow and ice crystal observation system during two winter seasons at a fixed sampling site near the summit of the central Sierra Nevada range of California. This research effort was performed as part of the Bureau of Reclamation's Sierra Cooperative Pilot Project (SCCP), an investigation of the technical feasibility and potential economic benefit of cloud seeding in the Sierra Nevada to supplement the region's water supply. Two specific photographic systems and their operational use are detailed. Data reduction and analysis techniques are also described. Conclusions are presented relating to three key topic areas. Those are (1) the suitability of the sampling equipment, sampling strategies and data acquisition/reduction techniques used in the SCPP application, (2) clues to seedability in Sierra storms and (3) the utility of ground-based microphysics measurements in evaluating seeding experiments. (Author)
W86-00222

**APPLICATION OF PROBABLE MAXIMUM PRECIPITATION ESTIMATES: UNITED STATES EAST OF THE 105TH MERIDIAN,**
National Weather Service, Silver Spring, MD. Office of Hydrology.
E. M. Hansen, L. C. Schreiner, and J. F. Miller.
Available from the Technical Information Service, Springfield, VA 22161 as PB83-118166. NOAA Hydrometeorological Report No. 52, August 1982. 168 p, 57 Fig, 31 Tab, 22 Ref, 1 Append.

Descriptors: *Precipitation, *Rainfall, Rainstorms, Maximum probable precipitation, Meteorology, Storms, Isohyets, Temporal distribution, Spatial distribution, Distribution, Estimating.

A stepwise approach to adapting the temporal and spatial distribution of probable maximum precipitation estimates to a specific drainage is given. An elliptical isohyetal pattern with a ratio of major to minor axes of 2.5 to 1 is recommended. Procedures are outlined for obtaining appropriate isohyet values and for determining probable maximum precipitation values for durations less than 6 hours. The shape and orientation of isohyetal patterns for major rainfalls of record are included. An appendix lists storm duration, storm area, and 24-hour rainfall for 253 major storms from 1878 to 1972.
W86-00229

**BOULDER UPSLOPE CLOUD OBSERVATION EXPERIMENT.**
National Oceanic and Atmospheric Administration, Boulder, CO. Environmental Research Labs.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-116673. June 1982. Earl E. Gossard, editor. 237 p, 34 Fig, 14 Tab, 2 Ref, 2 Append.

Descriptors: *Precipitation, *Cloud physics, *Remote sensing, *Meteorologic data collection, Upslope precipitation, Ice, Snow, Fog, Radar, Radiometers, Lidar, Aircraft, Ceilometer, Boulder Upslope Cloud Observation Experiment, Data collections, Crystals, Microwaves, Weather.

The Boulder Upslope Cloud Observation Experiment was designed to learn more about the role of ice crystals in the formation of clouds and precipitation under upslope conditions; to calibrate the remote sensing systems against reliable in situ devices in a steady, homogeneous cloud environment; and to evaluate the systems' applicability for observing the role of ice crystals and cloud microphysics in the evolution of upslope precipitation. Eleven principal weather events in the spring of 1982 are described. In situ measurements were made by aircraft, tower particle measurements, surface chemistry sampling, all-sky camera, and rotating beam ceilometer. Ground-based remote sensing measurements were made by radiometer, radar, and lidar.
W86-00261

**POSTSTORM RECONNAISSANCE OF TROPICAL STORM CHRIS,**
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
T. H. Flor.
Miscellaneous Paper HL-83-5, July 1983. Final Report. 18 p, 9 Fig, 6 Append.

Descriptors: *Precipitation, *Storms, Tropical Storm Chris, *Flood damage, Tidal floods, Shores, Seashores, Damage, Rainstorms.

Tropical Storm Chris made landfall in Louisiana, 7 miles east of Sabine Pass, Texas, at 0600 CDT on September 11, 1982. Highest sustained winds were 55 knots. Lowest pressure was estimated to be 994 mbs. Highest tides were between 5 and 6 feet just east of the center. Rainfall was 5 to 10 inches in Louisiana, with a few local amounts greater than 10 inches. The highest storm-generated surge, 8.5-9 ft, occurred at Peveto Beach, 8 miles east of the point of landfall. Flooding west and east of the point of landfall was 2.8 ft above predicted tide level 17 miles to the west and 2.5 ft above predicted tide 19 miles to the east. No casualties were reported. Damage estimates were < $1 million in Louisiana. Power lines, trees, and boats were also damaged, as well as a restaurant in Texas.
W86-00279

**CLOUD PHYSICS STUDIES IN THE SCPP: INTERIM PROGRESS REPORT, 1983-84.**
Wyoming Univ., Laramie. Dept. of Atmospheric Science.
For primary bibliographic entry see Field 3B.
W86-00305

**STRUCTURE OF COLD FRONTS OVER CALIFORNIA,**
Wyoming Univ., Laramie. Dept. of Atmospheric Science.
For primary bibliographic entry see Field 3B.
W86-00306

**RESPONSES TO SEEDING CLOUDS WITH DRY ICE IN THE SCPP-1 EXPERIMENT,**
Wyoming Univ., Laramie. Dept. of Atmospheric Science.
For primary bibliographic entry see Field 3B.
W86-00307

## 2C. Snow, Ice, and Frost

**RUNOFF FROM GLACIERIZED MOUNTAINS: A MODEL FOR ANNUAL VARIATION AND ITS FORECASTING,**
Stirling Univ. (Scotland). Dept. of Environmental Science.
For primary bibliographic entry see Field 2E.
W86-00077

**SNOWMELT INDUCED URBAN RUNOFF IN NORTHERN SWEDEN,**
McMaster Univ., Hamilton (Ontario).
L. Bengtsson.
In: Proceedings of Stormwater and Water Quality Model User Group Meeting, January 27-28, 1983, University of Florida, Gainesville. p 215-236, 6 Fig, 11 Tab, 10 Ref.

Descriptors: *Snowmelt, *Runoff, *Snowpack, *Design criteria, *Melting, *Urban runoff, *Surface runoff, *Overland flow, Annual runoff, Soil water, Infiltration rate, Infiltration capacity, Snow cover, Thaw, Urban hydrology.

Snowmelt and runoff data collected at different sites in the Lule region of Sweden over a 7 yr period are summarized and analyzed. The maximum observed melt flux to the base of a snowpack during 1 h is 4.1 mm/h. The maximum observed daily melt is 40 mm, but the daily melt of a 2-yr return period is only 20 mm. The runoff from small study plots, at least in practical considerations, is found to be distributed over about 12 h. The maximum observed runoff from these study plots of hard packed gravel or grass surfaces is about 2 mm/h. In the late phase of a snowmelt period, the daily runoff closely corresponds to the daily melt. However, the very maximum runoff values are observed during or some days after the snowmelt period. Overland flow or flow just below the ground surface takes place. Design melt rates for open areas in Sweden are 20 mm/12 h for a melt rate of 1-yr return period and 3 mm/h for a shorter interval. For urban areas a value of at least 30 mm/12 h is suggested. For forested areas the value should be 10 mm/12 h. Rain during the snowmelt should be added to the melt. If there is much rain in the autumn and soil temperatures are low before snow cover is formed, overland flow should take place from all surfaces in the late snowmelt period. If the soil is packed hard, the runoff may correspond to the melt rate.
W86-00097

## 2D. Evaporation and Transpiration

**COMPARING THE PERFORMANCE OF ROOT-WATER-UPTAKE MODELS,**
Katholieke Univ. Leuven (Belgium). Lab. of Soil Physics.
M. Alaerts, M. Badji, and J. Feyen.
Soil Science, Vol. 139, No. 4, p 289-296, April, 1985. 6 Fig, 2 Tab, 8 Ref.

Descriptors: *Root-water-uptake models, *Soil water, *Model studies, Sink terms, Root-water-extraction terms, Hydrologic budget, Nitrogen budget, Transpiration, Nutrient removal, Nutrient uptake.

To model the water balance of a cropped soil, a root-water-extraction term, the so-called sink term, is added to the general flow equation describing the water flow in the unsaturated zone. To compare different proposed sink-terms, they should be used as variable components of the same field water budget model. Four root-water-extraction terms selected from the literature were adapted and inserted into the field water budget model SWATRE. The models were run with simplified initial and boundary conditions and showed agreement with regard to the cumulative water loss over a period of 20 d, if the input data and parameter values were adjusted. They resulted, however, in significantly different daily water-extraction-depth patterns. The most sophisticated model appears to contain a number of redundant terms, and the least complicated model could not be applied when a water table was present. The water-extraction-depth pattern is of special importance if the water budget model is used as a component of, for example, a nitrogen budget model. The simulated nutrient uptake will depend greatly on the moisture extraction pattern. Choice of sink term might be difficult under real field conditions and with validation data available. All sink terms require the choice of parameters adapted to the particular soil-plant combination. This almost automatically implies some data-fitting, because independent data for similar conditions are rarely available, and the knowledge for extrapolating from different conditions is lacking. Too little seems to be known about plant transpiration and water extraction patterns to result in a general extraction term which is simple and economical to use and satisfying in concept and results. (Collier-IVI)
W86-00048

## 2E. Streamflow and Runoff

**NUMERICAL MODELLING OF SUBCRITICAL OPEN CHANNEL FLOW USING THE K-EPSILON TURBULENCE MODEL AND THE PENALTY FUNCTION FINITE ELEMENT TECHNIQUE,**
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Civil Engineering.
A. N. Puri, and C. Y. Kuo.

Applied Mathematical Modelling, Vol. 9, No. 2, p 82-88, April, 1985. 8 Fig, 1 Tab, 21 Ref.

Descriptors: *Mathematical models, *Open-channel flow, *Turbulent flow, *Penalty function, *Finite element method, Curved channels, Flow, Channel flow, Momentum dispersion models, Turbulence closure models.

A numerical model has been developed that employs the penalty function finite element technique to solve the vertically averaged hydrodynamic and turbulence model equations for a water body using isoparametric elements. Solving of the full elliptic forms of the equations allowed recirculating flows to be calculated. Alternative momentum dispersion and turbulence closure models were evaluated by comparing model predictions with experimental data for strongly curved subcritical open channel flow. The results of these simulations indicate that the depth-averaged two-equation K-epsilon turbulence model yields excellent agreement with experimental observations. Neither the streamline curvature modification of the depth-averaged K-epsilon model, nor the momentum dispersion models based on the assumption of helicoidal flow in a curved channel, yield significant improvement in the present model predictions. Overall model predictions were found to be as good as those of a more complex and restricted three-dimensional model. (Author's abstract)
W86-00003

**SPATIALLY VARYING RAINFALL AND FLOODRISK ANALYSIS,**
Massachusetts Inst. of Tech., Cambridge.
R. L. Bras, D. R. Gaboury, D. S. Grossman, and G. J. Vicens.
Journal of Hydraulic Engineering, Vol. 111, No. 5, p 754-773, May, 1985. 10 Fig, 5 Tab, 7 Ref.

Descriptors: *Rainfall distribution, *Floodrisk analysis, *Flood forecasting, *Cumberland River Basin, *Kentucky, *Tennessee, *Simulation analysis, Model studies, Rainfall-runoff relationships, Discharge frequency.

A mathematical simulation model of the spatial and temporal rainfall process was developed and used to input to distributed rainfall-runoff models in order to obtain streamflow series at multiple locations in large river basins. Frequency analysis under different basin development and control alternatives can then be performed. A location in the Cumberland River Basin (Kentucky and Tennessee) was studied. The basin is 46,397 sq km (17,914 sq mile) and thus exhibits large rainfall variability in space. The rainfall model was calibrated with 28 yr of hourly and daily rainfall data in 274 stations in and around the basin. By using generated rainfall as input to a previously calibrated distributed rainfall-runoff model, discharge frequency curves were obtained at 14 locations. The curves corresponded to both the system with eight operational flood control reservoirs and the natural system without regulation. (Author's abstract)
W86-00012

**METHOD OF PREDICTING DAILY PEAK FLOWS IN THE HIGH-FLOW SEASON,**
Saskatchewan Univ., Saskatoon. Dept. of Geography.
P. R. Waylen.
Journal of Hydrology, Vol. 77, p 89-105, 1985. 7 Fig, 1 Tab, 21 Ref.

Descriptors: *Peak flows, *Flood forecasting, *Seasonal distribution, *British Columbia, Streamflow forecasting, Forecasting, Orographic precipitation, Data interpretation, Statistical analysis, Model studies.

Partial duration series provide a method of obtaining the distributions of both high-flow variables and annual floods. The seasonal nature of streamflow requires assumptions of nonhomogeneity of the timing of events. The modeling of timing is based upon the temporal behavior of high flows generated by distinct processes. The approach is physically meaningful and able to accommodate several generating processes. In southern British Columbia, Canada, snowmelt and rainfall produce high flows. Individually the distribution of each set of annual maxima produced by the respective processes are successfully represented by a double exponential distribution which, compounded, provide a good fit in locations of mixed generating processes. In all cases introduction of the time nonhomogeneity term to the double exponential for periods of less than 1 yr. provides a good fit to the observed distribution of daily peak flows throughout the high-flow season. (Author's abstract)
W86-00027

**DISCRETE-TIME LINEAR CASCADE UNDER TIME AVERAGING,**
National Hydrology Research Inst., Ottawa (Ontario).
For primary bibliographic entry see Field 2A.
W86-00028

**GOULD'S PROBABILITY MATRIX METHOD; 1. THE STARTING MONTH PROBLEM,**
Melbourne Univ., Parkville (Australia). Dept. of Civil Engineering.
R. Srikanthan, and T. A. McMahon.
Journal of Hydrology, Vol. 77, p 125-133, 1985. 3 Fig, 1 Tab, 10 Ref.

Descriptors: *Streamflow, *Gould's probability matrix, Australia, Rivers, Reservoirs, Probability distribution.

A major problem of water-supply authorities is to determine the relationship of the capacity of a large reservoir with its inflows and potential releases. Annual and/or monthly streamflow data for nine Australian rivers covering a range of characteristics are used to aid in solving this problem. Mean monthly flows (expressed as percentages of annual flow) and the annual coefficients of variation and lag-1 autocorrelation coefficients for different starting months are shown. Results based on synthetic data indicate that in Gould's probability matrix method the yearly routing of monthly flows should start in a month of low mean monthly flow. Results from historical data also indicated this, but are masked by the sample variability of the estimates. For analysis, the monthly data should be assembled into years defined by the water year which should begin and end normally during a time of low flow. (Baker-IVI)
W86-00029

**GOULD'S PROBABILITY MATRIX METHOD; 2. THE ANNUAL AUTOCORRELATION PROBLEM,**
Melbourne Univ., Parkville (Australia). Dept. of Civil Engineering.
R. Srikanthan, and T. A. McMahon.
Journal of Hydrology, Vol. 77, p 135-139, 1985. 3 Fig, 1 Tab, 4 Ref.

Descriptors: *Gould's probability matrix, *Streamflow, *Autocorrelation, Reservoirs, Water supply, Water storage, Flow.

The effect of lag-1 annual autocorrelation on storage sizes obtained from Gould's probability matrix method is examined using long sequences of generated data. The range of applicability of Gould's method and the associated correction factors for annual autocorrelation are proposed. The correction factor to take into account the annual autocorrelation coefficient was found to depend mainly on the annual lag-1 autocorrelation coefficient, r, and storage size. Except for a few limited combinations of r, annual coefficients of variation (Cv), and draft, the correlation factor is larger than 1.5, implying Gould's transition probability matrix method is not a suitable procedure for rivers with significant annual autocorrelation coefficients. Gould's procedure may be used for small r (0.2) so long as the correction factor is not greater than 1.5. Correction factors are presented. (Baker-IVI)
W86-00030

**VARIANCE OF THE T-YEAR EVENT IN THE LOG PEARSON TYPE-3 DISTRIBUTION,**
Asian Inst. of Tech., Bangkok (Thailand).
H. N. Phien, and L.-C. Hsu.
Journal of Hydrology, Vol. 77, p 141-158, 1985. 6 Tab, 11 Ref.

Descriptors: *Floods, *Rainfall, *Distribution, *Log Pearson type-3 distribution, Mathematical equations, Variance, Computers.

Detailed schemes for computing the variance of the T-yr. event, the variances and covariances of the parameter estimates for the LP3 distribution were described along with the provision of analytical formulae for all related computations. Variances and covariances are analytically derived in this study for the case where the parameters are estimated by the methods of direct and mixed moments. The examples given clearly show that the error committed in estimating the parameters of the LP3 distribution was very high, and the highest error seemed to take place in estimating the shape parameter. At present, an attempt is being made to apply the presented computational schemes to many more data sets of annual floods and annual maximum rainfalls, whereby general conclusions may be drawn on the performance of the different methods for parameter estimation. To help the evaluation process, a set of computer programs in FORTRAN have been developed according to the schemes presented in this paper. (Baker-IVI)
W86-00031

**COMPARISON OF TWO DAILY STREAMFLOW SIMULATION MODELS OF AN ALPINE WATERSHED,**
Colorado Univ. at Boulder. Dept. of Civil, Environmental, and Architectural Engineering.
C. M. Brendecke, D. R. Laiho, and D. C. Holden.
Journal of Hydrology, Vol. 77, p 171-186, 1985. 6 Fig, 2 Tab, 20 Ref.

Descriptors: *Alpine areas, *Streamflow, *Simulation, *Model studies, *Colorado, Computer models, Data interpretation, Hydrograph, Rainfall-runoff relationships, Hydrologic models.

A comparison of daily streamflow simulation by two different computer models has been completed for an alpine basin in central Colorado, U.S.A. The catchment is part of a 33-sq km area providing most of the City of Boulder's raw water supply. It is located between 2964 and 4103 m a.s.l. in elevation along the Continental Divide 24 km west of Boulder, Colorado. The Streamflow Synthesis and Reservoir Regulation model, which makes generous use of lumped-type parameters, was compared with the Precipitation Runoff Modeling System (PRMS) model, which makes greater use of individually defined parameters, by examining their respective ability to fit observed hydrograph volumes and shape. Both computer models were found to simulate streamflow equally well. The PRMS model was found to be more suitable overall because of its ability to handle small catchments and the generous use of individual physically-based parameters. (Author's abstract)
W86-00033

**DETERMINATION OF RESISTANCE PARAMETERS OF PLUVIO-NIVO-GLACIAL ALPINE SYSTEMS BY MATHEMATICAL MODELING OF RUNOFF,**
Vrije Univ., Amsterdam (Netherlands). Dept. of Hydrogeology and Geographical Hydrology.
A. A. Van De Griend, and E. Seyhan.
Journal of Hydrology, Vol. 77, p 187-207, 1985. 7 Fig, 1 Tab, 42 Ref.

Descriptors: *Alpine regions, *Mathematical models, *Runoff, *Hydrologic models, *Italy, Rainfall-runoff relationships, Glaciohydrology, Snowmelt, Geohydrology.

A nonlinear optimization technique has been applied to analyze complex hydrographs from an alpine catchment with pluvial, nival and glacial regime components, in order to determine bulk resistance parameters of the contributing systems. Both the fluvial system and the nivo-glacial system

are represented by a linear system function. Application of the optimization model to monthly time series of daily runoff, revealed the time variability of the systems operation which reflects the seasonal variability of hydro(geo)logical and snow-hydrological conditions relevant for the creation of runoff. The model has been applied to a northern Italian Alpine catchment with a runoff record of 22 yr. (Author's abstract)
W86-00034

**MULTIPLE NONLINEAR STATISTICAL MODELS FOR RUNOFF SIMULATION AND PREDICTION,**
Alcoa of Australia Ltd., Applecross.
E. N. Tsykin.
Journal of Hydrology, Vol. 77, p 209-226, 1985. 1 Fig, 3 Tab, 9 Ref, 3 Append.

Descriptors: *Statistical models, *Runoff, *Prediction, Model studies, Rainfall-runoff relationships, Hydrologic models, Soil water.

The lack of accuracy of statistical rainfall-runoff models is often caused by lack of correspondence between the nonlinear structure of the process and the linear structure of the statistical equation. Multiple nonlinear equations with separate antecedent soil-moisture indices for each time period and with a combined intercept allow the modeling of rainfall-runoff relations with high accuracy. The coefficients of determination between actual and simulated runoff for the calibration periods are typically higher than 0.90 and often as high as 0.96. Extrapolation over periods 3-4 times longer than the calibration have provided accurate predictions, with corresponding R2-values of 0.85 and higher. Extrapolations using these models are accurate even when the calibration period is relatively short and its range is smaller than the range of the predicted values. (Collier-IVI)
W86-00035

**ESTIMATES OF PEAK RUNOFF FROM HILLY TERRAIN WITH VARIED LITHOLOGY,**
International Inst. for Aerial Survey and Earth Sciences, Enschede (Netherlands).
A. M. J. Meijerink.
Journal of Hydrology, Vol. 77, p 227-236, 1985. 6 Fig, 9 Ref.

Descriptors: *Peak runoff, *Runoff, *Topography, *Lithology, *Italy, *Spain, *India, *Tunisia, *Carinena, Slope-area method, Geomorphology, Streamflow, Rainfall distribution, Soil conservation.

Rainfall data for shorter durations may not be adequate in areas with strong relief; in such cases the common engineering formulas for the estimations of the peak discharges are difficult to apply. It may also not be feasible to use empirical formulas based on regression analyses from nearby regions. For estimating the peak flows one may have to resort to the use of the slope-area method and survey channel sections. Estimates of peak runoff were made using the slope-area method in hilly regions with poor adjustment of channel morphology to high flows. Geomorphological maps were made for each of four areas studied. The main units coincided with the geology and within each of the main units, channel reaches were surveyed. Small rivers were investigated in four areas: A basilicata area in southern Italy; the area around Carinena in central Spain; the area around Bata Nala-Renuka, Himachal Pradesh in north India; and the area around Kasserine in southwestern Tunisia. Despite the inaccurate nature of the methods, a meaningful interpretation of the results could be made. In the two Mediterranean areas the effects of the highly differing morpholithological units on the peak runoff could be demonstrated, although estimates of few catchments have been used. The method is not sensitive enough to reflect the effects of less pronounced morphologic variations and supposed geographic variations in rainfall intensities; this is indicated by the results of the area in northern India. In the semi-arid area of Kasserine the lithology and geomorphology did not seem to affect the peak flows with great return periods. The method may contribute to improved methods in soil and water conservation, and estimates of the capacities of cross-drainage works. An idea of the internal variation of direct response within larger catchments can also be obtained. (Collier-IVI)
W86-00036

**CONDENSED DISAGGREGATION MODEL FOR INCORPORATING PARAMETER UNCERTAINTY INTO MOUTHLY RESERVOIR SIMULATIONS,**
Cornell Univ., Ithaca, NY. Dept. of Environmental Engineering.
J. R. Stedinger, D. Pei, and T. A. Cohn.
Water Resources Research, Vol. 21, No. 5, p 665-675, May, 1985. 7 Fig, 5 Tab, 74 Ref. NSF grant CME 8010889.

Descriptors: *Reservoirs, *Simulation, *Boise River, *Rappahannock River, Model studies, Parameters, Distribution, Water supply, Water shortages, Reservoir failure.

A condensed version of the Valencia-Schaake disaggregation model was developed which describes the distribution of monthly streamflow sequences using a set of coupled univariate regression models rather than a multivariate time series formulation. The model is attractive because it has fewer parameters but can still reproduce the means, variances, and period to period correlations of the individual flows while approximately preserving the relationship among the monthly and annual flow values. The simple autoregressive form of the condensed disaggregation model facilitates the use of Bayesian inference theory to describe uncertainty as to the most appropriate values of the model's parameters. This allows construction of a two stage streamflow generation procedure which captures both the uncertainty as to what the model's parameters might be and the characteristics of flow sequences a model with those parameters might generate. The differences in estimates of reservoir system performance statistics due to the choice of different but reasonable models are generally relatively modest. The limited information available to estimate the parameters of the chosen model can have a striking and serious impact on the ability to specify how a given reservoir system is likely to perform in the future. Modeled sequences describe flows in the Rappahannock River in Virginia and the Boise River in Idaho. For high-reliability systems the results show that streamflow generation procedures which ignore model parameter uncertainty can grossly underestimate reservoir system failure rates and the severity of likely shortages, even if based on a 50-year record. (Baker-IVI)
W86-00073

**INTERANNUAL STEAMFLOW VARIABILITY IN THE UNITED STATES BASED ON PRINCIPAL COMPONENTS,**
Geological Survey, Reston, VA.
H. F. Lins.
Water Resources Research, Vol. 21, No.5, p 691-701, May, 1985. 8 Fig, 3 Tab, 20 Ref.

Descriptors: *Streamflow, *Variability, *Principal component analysis, Time series analysis, Flow, Autocorrelation.

Interannual modes of streamflow variation at 106 locations across the United States during the period 1931-1978 are defined by using principal components. Nearly 60% of the total variance could be explained by five principal components. Each component describes a spatially distinct mode of variation in terms of the departure of flows from period-of-record mean conditions. Thus the first principal component represents a uniform nationwide function; the second, a north-south opposition in flow departures; the third, an east-west opposition; the fourth, a coastal-continental opposition; and the fifth, a northern plains-southern plains opposition. Each successive principal component describes an increasingly more regional pattern of streamflow variation. These component patterns, especially the first three, exhibit considerable spatial stability based on similar analyses using altered data sets. Temporally, component stability is less certain, except in the case of the first component. Time series analysis of component scores indicates that most component functions are best described as AR(1) processes. Component four, the coastal-continental flow opposition function, appears to be an AR(2) process. Given the characteristics of principal components to describe the most organized modes of variation in a data set, it is not surprising that four of the first five components have stronger autocorrelation functions at low lags than does mean annual streamflow. Principal components can be used to identify the primary modes of variability in large multivariate fields of streamflow data. The principal components of streamflow exhibit more persistence than mean annual streamflow. For certain applications involving the analysis of large spatial and long temporal sets of flow data, parsimony without significant compromise in information may be achieved using principal components. (Baker-IVI)
W86-00076

**RUNOFF FROM GLACIERIZED MOUNTAINS: A MODEL FOR ANNUAL VARIATION AND ITS FORECASTING,**
Stirling Univ. (Scotland). Dept. of Environmental Science.
R. I. Ferguson.
Water Resources Research, Vol. 21, No. 5, p 702-708, May. 1985. 5 Fig, 3 Tab, 17 Ref.

Descriptors: *Snowmelt, *Runoff, *Glaciers, *Mountains, *Streamflow, Snow, Ice, Forecasting, Satellite technology, Snowcover, Snow accumulation, Remote sensing, Orographic variation.

For remote high mountain basins, such as the upper Indus in Pakistan, the only means of forecasting spring and summer runoff is from preseason snow cover on satellite images. Previous studies have shown that regression coefficients of runoff on snow cover differ between basins in magnitude and sign. A simple formal analysis of annual meltwater yield from high mountain basins explains why its relationship with preceding snow cover varies from basin to basin in sign and sensitivity and identifies a number of additional glacio-climatic parameters that are relevant but cannot be determined from preseason satellite imagery. A simple but flexible parameterization of orographic variation in snow accumulation and potential snowmelt enables prediction of annual meltwater runoff from the extent of winter snow cover, with bounds attached to allow for variation in summer heat input to glacier ablation zones. The moderating influence of glaciers on runoff gives way in highly glacierized basins to an inverse relationship between annual meltwater runoff and preceding snow cover. The critical glacier extent may be a slow as 10-20% where there is a strong orographic increase in snow accumulation. The value of satellite imagery for forecasting meltwater yield from high mountains would be improved by using late summer images to estimate glacierized areas, firn zone extent, and a latter's year to year variation. Even so there is still a need for ground investigation of the spatial, especially orographic, variation in snow accumulation and potential snowmelt. (Baker-IVI)
W86-00077

**MINIMUM VARIANCE STREAMFLOW RECORD AUGMENTATION PROCEDURES,**
Tufts Univ., Medford, MA. Dept. of Civil Engineering.
R. M. Vogel, and J. R. Stedinger.
Water Resources Research, Vol. 21, No. 5, p 715-723, May, 1985. 7 Fig, 4 Tab, 25 Ref.

Descriptors: *Floods, *Streamflow, *Variance, Estimating, Flood peaks, Sampling, Matalas-Jacobs estimators.

Augmentation procedures have been recognized as a useful approach for estimating the mean and variance of short hydrologic records. Approaches for augmentation of short-streamflow records have exploited the cross-correlation among flows at two or more gages to obtain maximum likelihood estimates of the mean and variance of the flows at the

short-record gage. Estimators of the mean and variance of the flows at a short record site were derived which should have lower variance than the unbiased maximum likelihood or Matalas-Jacobs estimators for the small samples of interest in hydrology. Since the Matalas-Jacobs estimators as well as the estimators introduced in this study require an estimate of the flow's cross correlation p, a Monte-Carlo experiment was performed to evaluate the impact of using the sample cross-correlation on their root mean square error (rmse). In general, these estimators have essentially an equal or, as is more often the case, a lower rmse than the Matalas-Jacobs estimators. The sampling properties of estimators of the mean and variance of the flows at the short record site were examined. The potential advantages and limitations of these new estimators are discussed within the framework of augmentation and/or extension of both peak annual floods and also monthly streamflow records. (Baker-IVI)
W86-00079

**UNIT HYDROGRAPH APPROXIMATIONS ASSUMING LINEAR FLOW THROUGH TOPOLOGICALLY RANDOM CHANNEL NETWORKS,**
Geological Survey, Lakewood, CO. Water Resources Div.
B. M. Troutman, and M. R. Karlinger.
Water Resources Research, Vol. 21, No. 5, p 743-754, May, 1985. 4 Fig, 27 Ref, 1 Append.

Descriptors: *Runoff, *Drainage basins, *Flow, *Unit hydrographs, Mathematical equations, Laplace equation, Precipitation, Drainage, Surface flow.

One of the important processes in defining runoff response of a drainage basin, movement of water on the surface through a channel network, is considered. Infiltration, subsurface flow, and overland flow are not considered. The instantaneous unit hydrograph (IUH) of a drainage basin is expressed as a function of (alpha, beta, N), of (alpha, beta, N, D) and of (alpha, beta, N, M). The parameter alpha characterizes the link (channel segment) lengths, beta is a hydraulic parameter, N is number of first-order streams, D is diameter (mainstream length), and M is order. Obtaining the IUH may involve numerical solution of the difference equation or numerical inversion of a Laplace transform. Both of these tasks, however, are readily performed on a digital computer. The IUH is derived based on assumptions that the links are independent and identically distributed random variables and that the network is a member of a topologically random population. Linear routing schemes, including translation, diffusion, and general linear routing are used, and constant drainage density is assumed. By using (N, alpha, beta) as the fundamental basin characteristics, asymptotic (for large N) considerations lead to a Weibull probability density function for the IUH. This asymptotic IUH is identical for all linear routing schemes. (Baker-IVI)
W86-00082

**PROBABILISTIC STRUCTURE OF STORM SURFACE RUNOFF,**
Universidad Simon Bolivar, Caracas (Venezuela). Graduate Program in Hydrology and Water Resources.
J. R. Cordova, and I. Rodriguez-Iturbe.
Water Resources Research, Vol. 21, No. 5, p 755-763, May, 1985. 7 Fig, 5 Tab, 8 Ref, 1 Append. Venezuela National Research Council grant S1-1212.

Descriptors: *Rainfall intensity, *Storm runoff, *Rainfall-runoff relationships, Probability, Storms, Infiltration, Mathematical equations.

The mean and variance of storm surface runoff are derived under the assumption that storm events are rectangular pulses with a bivariate exponential distribution for the intensity and duration of the storm. The Philip infiltration equation is used to make the transformation between rainfall and surface runoff. The probability of zero storm surface runoff mean and variance of storm surface runoff is also calculated under the same assumptions. The correlation between intensity and duration of the storm has an important impact on the probabilistic structure of storm surface runoff. The correlation between intensity and duration of the storm has an important impact on the probabilistic structure of storm surfce runoff. Equations are given which take into account such a correlation and provide the hydrologist with a way to estimate the mean and variance of storm surface runoff. It is not advisable to assume beforehand that intensity and duration are uncorrelated random variables, and an effort should be made to estimate the correlation between these climatic characteristics. The correlation between intensity and duration increases the probability of occurrence of storm surface runoff, which shows a significant increase for soil moisture contents above 60%. (Baker-IVI)
W86-00083

**HYDROLOGICAL REGIONALISATION: A QUESTION OF PROBLEM AND SCALE,**
Vrije Univ., Amsterdam (Netherlands).
I. Simmers, and E. Seyhan.
In: Proceedings of Stormwater and Water Quality Model User Group Meeting, January 27-28, 1983, University of FLorida, Gainesville. p 202-214, 6 Fig, 3 Tab, 20 Ref.

Descriptors: *Streamflow, *Runoff, *Hydrologic models, *Catchment areas, *Regional analysis, *Hydrologic data collection, *Surface runoff, Data collections, Model studies, Watersheds, Land use, Spatial distribution, Models, Topography.

Parameter prediction for ungauged catchment areas and regionalization of hydrological data depend on two fundamental issues - the problem to be resolved and the scale at which a solution is required. A simplified, dynamic method for regionalization of hydrological data is presented which encompasses these issues and is currently being applied to an ongoing study in east Luxembourg. Since the problem to be resolved in two catchments (the Tollbach and the Dosbach) involves prediction of hydrological response consequent upon land use change, the scale is small and requires the consideration of the dynamic spatial variation in discharge source areas. Data collection was initiated from a regionalized sampling matrix technique according to topography, vegetative cover, and nature of surficial deposits. The watershed is thus regarded as a system which consists of a series of homogenous units each contributing to runoff formation and streamflow generation. The described approach to regionalization is considered robust and, if combined with remote sensing, should minimize instrumental and data collection requirements.
W86-00096

**ADVANCEMENT IN HYDRAULIC MODELING OF POROUS PAVEMENT FACILITIES,**
Espey, Huston and Associates, Inc., Austin, TX.
G. F. Goforth.
In: Proceedings of Stormwater and Water Quality Model User Group Meeting, January, 27-28, 1983, University of Florida, Gainesville. p 237-254, 8 Fig, 3 Tab, 5 Ref.

Descriptors: *Urban runoff, *Porous pavement, *Surface runoff, *Storm runoff, *Simulation analysis, *Drainage engineering, *Porous media, *Paving, *Hydraulic models, Runoff, Models, Model studies, Urban hydrology, Hydrologic budget, Storm seepage, Asphalt.

A porous pavement facility is an innovative solution to the problems of stormwater drainage from parking and other low density traffic areas in urban landscapes. Stormwater hydraulic characteristics of porous and nonporous pavement sites were evaluated using a revised version of the computer model PORPAV. PORPAV is a two-dimensional dynamic water budget analysis of a pavement facility which was initially developed for use in the EPA Storm Water Management Model. The utilization of PORPAV allows a comprehensive analysis of flow and storage in pavement facilities to aid in comparisons of the hydraulic response of alternative pavement designs. Monitoring surveys and stormwater simulations using PORPAV were carried out on three parking lots made of porous asphalt, gravel trench material, and conventional asphalt, respectively. Results showed that PORPAV satisfactorily simulated sprinkler-generated stormwater hydraulics of both porous and nonporous pavement facilities. Sprinkler application rates ranged from 0.4 to 1.7 inches/hr. Observed runoff ranged from 37 to 73% of recorded sprinkler inflow for the porous asphalt lot, 64 to 73% of recorded sprinkler inflow for the gravel trench lot and 71 to 118 volume % of recorded rainfall for the conventional asphalt lot.
W86-00098

**TIME-OF-TRAVEL DATA FOR NEBRASKA STREAMS, 1968 TO 1977,**
Geological Survey, Lincoln, NE. Water Resources Div.
L. R. Petri.
Available from the OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Open-File Report 84-602, 1984. 63 p, 17 Fig, 20 Tab, 6 Ref.

Descriptors: *Dye-tracing, *Time-of-travel measurements, *Surface-water discharge, *Nebraska, Streams.

This report documents the results of 10 time-of-travel studies, using 'dye-tracer' methods, conducted on five streams in Nebraska during the period 1968 to 1977. Streams involved in the studies were the North Platte, North Loup, Elkhorn, and Big Blue Rivers and Salt Creek. Rhodamine WT dye in a 20 percent solution was used as the tracer for all 10 time-of-travel studies. Water samples were collected at several points below each injection site. Concentrations of dye in the samples were measured by determining fluorescence of the sample and comparing that value to fluorescence-concentration curves. Stream discharges were measured before and during each study. Results of each time-by-travel study are shown on two tables and on graph. The first table shows water discharge at injection and sampling sites, distance between sites, and time and rate of travel of the dye between sites. The second table provides descriptions of study sites, amounts of dye injected in the streams, actual sampling times, and actual concentrations of dye detected. The graphs for each time-of-travel study provide indications of changing travel rates between sampling sites, information on length of dye clouds, and times for dye passage past given points. (USGS)
W86-00120

**STREAMFLOW LOSSES ALONG THE BALCONES FAULT ZONE, NUECES RIVER BASIN, TEXAS,**
Geological Survey, Austin, TX. Water Resources Div.
L. F. Land, C. W. Boning, L. Harmsen, and R. D. Reeves.
Available from the OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigations Report 83-4168, 1983. 72 p, 36 Fig, 11 Tab, 4 Ref.

Descriptors: *Base flow, *Discharge measurement, Recharge, *Texas, *Streamflow losses, *Streamflow gains, Nueces River basin, Edwards aquifer.

An investigation was conducted to quantify and to determine distribution of streamflow losses and gains that occur during base flow conditions in the Balcones Fault Zone of the Nueces River basin. The streams studied include the West Nueces, Nueces, Dry Frio, Frio, and Sabinal Rivers, and Seco, Hondo, and Verde Creeks. Discharge measurements made during storm recession flows of these streams identified direct recharge to outcrops of the Edwards aquifer and related limestones that ranged from as high as 393 cubic feet per second for the Frio River to as low as 42 cubic feet per second for the Sabinal River. Recharge to outcrops of the Buda Limestone, Eagle Ford Shale, and Austin Group also eventually reaches the Edwards aquifer, and measurements identified losses to these formations ranging from as high as 174 cubic feet per second for the Frio River to near zero for Verde Creek. (USGS)

W86-00124

**WATER RESOURCES DATA FOR FLORIDA, WATER YEAR 1981 VOLUME 1: NORTHEAST FLORIDA,**
Geological Survey, Orlando, FL. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-00127

**WATER RESOURCES DATA FOR COLORADO, WATER YEAR 1982, VOLUME 2. COLORADO RIVER BASIN ABOVE DOLORES RIVER,**
Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-00128

**WATER RESOURCES DATA, NORTH DAKOTA, WATER YEAR 1981, VOLUME 1. HUDSON BAY BASIN.**
Geological Survey, Bismarck, ND. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-00129

**WATER RESOURCES DATA HAWAII, OTHER PACIFIC AREAS, WATER YEAR 1981. VOLUME 2. GUAM, NORTHERN MARIANA ISLANDS, FEDERATED STATES OF MICRONESIA, PALAU ISLANDS AND AMERICAN SAMOA.**
Geological Survey, Honolulu, HI. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-00130

**ATCHAFALAYA RIVER DELTA; REPORT 9: WIND CLIMATOLOGY,**
Coastal Engineering Research Center, Vicksburg, MS.
For primary bibliographic entry see Field 2L.
W86-00163

**ATCHAFALAYA RIVER DELTA; REPORT 8: NUMERICAL MODELING OF HURRICANE-INDUCED STORM SURGE,**
Coastal Engineering Research Center, Vicksburg, MS.
For primary bibliographic entry see Field 2A.
W86-00164

**PRELIMINARY USER'S MANUAL 3-D MATHEMATICAL MODEL OF COASTAL, ESTUARINE, AND LAKE CURRENTS (CELC3D),**
Aeronautical Research Associates of Princeton, Inc., NJ.
Y. P. Sheng.
Instruction Report D-84-1, April 1984. Final Report. Army Engineer Waterways Experiment Station, Vicksburg, MS. 52 p, 10 Fig, 3 Tab, 11 Ref, 2 Append.

Descriptors: *Finite difference methods, *Mathematical models, *Water currents, *Fluid mechanics, *Computer models, Models, Model studies, Hydrologic models, Simulation analysis, Estuaries, Lakes, Differential equations, Mathematical studies, Coastal waters.

An efficient and comprehensive three-dimensional finite-difference model of coastal, estuarine, and lake currents (CELC3D) has been developed and is currently operative on a VAX-11/780 minicomputer. This user's manual discusses the special model features, general structure of the CELC3D computer code, sub-program summary, input/output data, and data requirements, and gives an example calculation by simulating the tide- and wind-driven currents in the Mississippi coastal water of the Gulf of Mexico. The CELC3D code can be used for the computation of two- or three-dimensional unsteady currents in coastal, estuarine, or lake waters based on the free-surface model described in detail by Sheng (1983). The present version of the code contains no buffering scheme and is programmed to run entirely in the central memory. The CELC3D program solves the mean equations of fluid motion within a water body with respect to a right-handed Cartesian coordinate system located at the nominal water surface. These equations consist of the partial differential equations for surface displacement, vertically integrated velocities, three-dimensional velocities, temperature, salinity, density, and sediment concentration.
W86-00168

**CURRENT MEASUREMENTS IN THE COLUMBIA RIVER ESTUARY,**
Chalmers Univ. of Technology, Goeteborg (Sweden). Institutionen foer Kaernkemi.
For primary bibliographic entry see Field 2L.
W86-00181

**DEVELOPMENT OF A NUMERICAL MODELING CAPABILITY FOR THE COMPUTATION OF UNSTEADY FLOW ON THE OHIO RIVER AND ITS MAJOR TRIBUTARIES,**
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
B. H. Johnson.
Technical Report HL-82-20, August 1982. Final Report. 154 p, 83 Fig, 7 Tab, 8 Ref, 3 Append.

Descriptors: *Rivers, *Flow characteristics, *Navigation, *Locks, *Dams, Model studies, Mathematical models, Unsteady flow, Ohio River, Reservoir operation, Tributaries, Flood control, FLOWSED model, Levees, Sediment transport.

The FLOWSED model is a one-dimensional mathematical model for predicting open-channel unsteady flow conditions and sediment movement on the Ohio River. In this work the coefficients were selected to minimize sediment transport. FLOWSED, an implicit finite difference model, can be used to model a system containing any number of tributaries. The influences of locks and dams as well as levee overtopping are also included. This model cannot be applied to multiple connected systems with closed loops or distributary channels. FLOWSED was applied to the complete Ohio River systems, broken into four separate segments, in a calibration mode. Historical data from floods in 1964, 1972, and 1976 were used. Results at gages varied from excellent to encouraging. However, poor results were obtained on tributaries where crude geometry data were used.
W86-00220

**CHANNEL WIDTHS IN BENDS AND STRAIGHT REACHES BETWEEN BENDS FOR PUSH TOWING: HYDRAULIC MODEL INVESTIGATION,**
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
For primary bibliographic entry see Field 8B.
W86-00225

**AQUATIC HABITAT STUDIES ON THE LOWER MISSISSIPPI RIVER: RIVER MILE 480-530; REPORT 6: LARVAL FISH STUDIES PILOT REPORT,**
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
For primary bibliographic entry see Field 6G.
W86-00226

**GUIDE TO STREAM HABITAT ANALYSIS USING THE INSTREAM FLOW INCREMENTAL METHODOLOGY,**
Fish and Wildlife Service, Fort Collins, CO. Western Energy and Land Use Team.
For primary bibliographic entry see Field 6G.
W86-00251

## 2F. Groundwater

**DISPERSION IN ANISOTROPIC, HOMOGENEOUS, POROUS MEDIA,**
Baghdad Univ. (Iraq). Coll. of Engineering.
Q. N. Fattah, and J. A. Hoopes.
Journal of Hydraulic Engineering, Vol. 111, No. 5, p 810-827, May, 1985. 6 Fig, 1 Tab, 28 Ref, 1 Append.

Descriptors: *Dispersion, *Anisotropic media, *Homogenous media, *Porous media, *Groundwater movement, *Flow, Sand, Tensor models, Vectors, Model studies, Particle size, Path of pollutants.

A tensor model for the dispersion coefficient for saturated flow in anisotropic, homogeneous porous media was developed through evaluations. of tensor components from experiments with an anisotropic, homogenous porous medium, constructed from thin, alternating layers of two types of sand, having different mean particle sizes. Tests were conducted for flow parallel, perpendicular, and inclined at 60 degrees to the direction of the layers. The hydraulic conductivity and the longitudinal dispersion coefficient were second-rank tensors with equal and constant eccentricities and with major and minor principal axes oriented along and perpendicular to the direction of the sand layers, respectively. The lateral dispersion coefficient was a second-rank tensor whose principal axes were orthogonal to those of the hydraulic conductivity tensor and whose eccentricity increased with increasing seepage velocity. Two values of the off-principal diagonal dispersivities were nearly equal in magnitude but opposite in sign. Experimental results support the dispersion coefficient tensor model proposed in the investigation. (Author's abstract)
W86-00015

**FIELD OBSERVATIONS AND NUMERICAL EXPERIMENTS ON A DRYING FRONT IN A VOLCANIC ASH SOIL CALLED KANTO LOAM,**
Rissho Univ., Tokyo (Japan). Dept. of Geography.
M. Higuchi.
Journal of Hydrology, Vol. 77, p 253-262, 1985. 5 Fig, 4 Ref.

Descriptors: *Drying fronts, *Soil water, *Volcanic ash soil, *Kanto loam, *Japan, *Evaporation, *Numerical analysis, Mathematical studies, Solar radiation, Wind, Boundary conditions, Loam.

Field observations (in Japan) and numerical experiments were carried out to investigate the formation and advance of a drying front in a volcanic ash soil called Kanto loam in an evaporation-drying process. The drying front is a boundary between an upward flux zone above and a downward flux zone beneath. In field observations of an evaporation-drying process from August 27 to September 8, 1977 in the Kanto loam, drying fronts formed quite near the soil surface and shift down to a depth of 100 cm. Numerical experiments for four different evaporation rates (respec. 1.25, 2.5, 5 and 10 mm/day) indicated that drying fronts advance downward to a depth of approximately 100 cm in 10 days. The computed depths of the drying fronts for an evaporation rate of 2.5 mm/day agree well with the observations. (Author's abstract)
W86-00038

**BLOCK-GEOMETRY FUNCTIONS CHARACTERIZING TRANSPORT IN DENSELY FISSURED MEDIA,**
British Geological Survey, Wallingford (England).
J. A. Baker.
Journal of Hydrology, Vol. 77, p 263-279, 1985. 2 Fig, 2 Tab, 22 Ref, 2 Append.

Descriptors: *Block-geometry functions, *Saturated zone, *Groundwater movement, *Solute transport, Diffusion, Heat, Geologic fractures, Path of pollutants, Laplace equation, Aquifers, Fick's law, Darcy's law, Fourier's law, Fourier analysis.

Three forms of transport are of importance in aquifers and saturated soils: transport of the water itself; transport of solutes in the water; and transport of heat by the water. Transport in saturated media can be considered to consist of densely packed blocks of matrix material separated by fis-

sures. The equations describing transport in fissured media, where transport in the matrix blocks is diffusive, are reduced to the standard form of a differential equation for the fissure phase. Transport in the matrix material is assumed to be diffusive which requires the following conditions to apply in the above three cases, respectively: water flow in the porous matrix is described by Darcy's law; water is stationary in the porous matrix and the solute transport is described by Fick's law; and water is stationary in the matrix, if it is porous, and heat transport is described by Fourier's law. Under these commonly assumed conditions the mathematical description of transport in the matrix phase will be the same in all three cases. The transport equations can be reduced to a differential equation for transport in the fissure phase along with its boundary conditions. This equation contains a dimensionless function, the block-geometry function, which contains all the relevant information regarding the geometry of the matrix blocks. Several such block-geometry functions were derived for simple shapes and for mixtures of these shapes. Empirical generalizations to irregular geometries were proposed on the basis of the commmon properties of these functions. The quasi-steady-state model of fissure-maxtrix interaction can also be formulated within this mathematical framework, and can be readily compared with the diffusive model, especially with regard to asymptotic behavior. Numerical Laplace transform inversion should be used for evaluation of the potential (head, concentration or temperature) except when the analytic solution is very simple. (Collier-IVI)
W86-00039

**HYDRAULICS OF A WELL PUMPED WITH LINEARLY DECREASING DISCHARGE,**

Govind Ballabh Pant Univ. of Agriculture and Technology, Plantnagar (India). Dept. of Irrigation and Drainage Engineering.
H. C. Sharma, H. S. Chauhan, and S. Ram.
Journal of Hydrology, Vol. 77, p 281-291, 1985. 7 Fig, 10 Ref.

Descriptors: *Hydraulics, *Discharge, *Wells, *Pumping, *Formation constants, *Aquifers, Theis equation, Cooper-Jacob equation, Model studies.

Varying the discharge rate of a well with time makes the Theis and Cooper-Jacob methods inapplicable for determination of the formation constants of an aquifer. Analytical and graphical solutions for variable discharge cases are available for a few empirical or functional relationships. A number of other modes of variation of discharge with time are physically possible. A method was developed with the help of analytical and graphical solutions to determine aquifer constants by pumping the well with linearly decreasing discharge. The linearly decreasing discharge was simulated on a horizontal Hele-Shaw model. The transmissivity and storage coefficient were evaluated by using the type curve developed for a linearly decreasing discharge well. The solution gave fairly satisfactory values of aquifer constants. (Author's abstract)
W86-00040

**ANALYTICAL SOLUTIONS FOR PERIODIC WELL RECHARGE IN RECTANGULAR AQUIFERS WITH THIRD-KIND BOUNDARY CONDITIONS,**

Thessaloniki Univ., Salonika (Greece). School of Technology.
P. Latinopoulos.
Journal of Hydrology, Vol. 77, p 293-306, 1985. 7 Fig, 1 Tab, 11 Ref.

Descriptors: *Recharge, *Rectangular aquifers, *Aquifers, *Third-kind boundary conditions, *Boundary conditions, *Mathematical studies, Groundwater movement, Seasonal variation, Artificial recharge, Groundwater recharge, Perched aquifers.

Analytical solutions of groundwater flow in confined and unconfined homogeneous and isotropic aquifers are especially useful in understanding the physical processes on a local scale, as well as in checking numerical solutions for large-scale problems. Analytical solutions for groundwater flow in rectangular aquifers with third-kind boundary conditions in the case of a single-well recharging seasonally under any form of continuously varying recharge regime. The solutions can be used for a preliminary assessment of the groundwater response to artificial recharge schemes upon either perched aquifers or aquifers in contact with clogged river beds. Depending upon the desired final management goals, the most suitable recharge regime can be selected by trying various types of recharge rate variations at a first stage. The solutions can be used to check numerical solutions of large and more complex problems. (Collier-IVI)
W86-00041

**REGIONAL UNSTEADY INTERFACE BETWEEN FRESH WATER AND SALT WATER IN A CONFINED COASTAL AQUIFER,**

Ehime Univ., Matsuyama (Japan). Dept. of Ocean Engineering.
K. Inouchi, Y. Kishi, and T. Kakinuma.
Journal of Hydrology, Vol. 77, p 307-331, 1985. 12 Fig, 19 Ref.

Descriptors: *Saline-freshwater interface, *Coastal aquifers, *Confined aquifers, *Model studies, *Naka river estuary, *Kiki river estuary, *Japan, Aquifers, Groundwater level, Water level, Mathematical equations, Boundary conditions.

An areal two-dimensional model to describe the unsteady motion of the fresh-salt water interface and the groundwater level in a confined coastal aquifer was applied to the confined groundwater in the estuaries of the Naka and Kiki rivers in Japan. Two equations were derived starting from the basic equations of the groundwater flow; one equation of the effective water level and one equation of the interface. The first equation describes a very rapid variation of the effective groundwater level and the second equation describes a very slow variation of the interface with time. In order to find solutions of these equations under the boundary conditions in practical field problems, the numerical scheme based on Galerkin finite-element technique was employed. Using this numerical scheme, transient positions of the groundwater level and the interface were calculated in the above-mentioned two regions and compared with the available field data. The calculated results agreed well with the data. (Author's abstract)
W86-00042

**TWO ALGORITHMS FOR PARAMETER ESTIMATION IN GROUNDWATER FLOW PROBLEMS,**

Technische Hogeschool, Delft (Netherlands). Dept. of Civil Engineering.
F. C. Van Geer, and P. Van Der Kloet.
Journal of Hydrology, Vol. 77, p 361-378, 1985. 7 Fig, 1 Tab, 4 Ref.

Descriptors: *Algorithms, *Groundwater movement, *Piezometric head, *Model studies, Darcys law, Kalman filtering, Mathematical studies, Pumping tests.

In groundwater flow problems the system variables are groundwater levels, piezometric levels and water velocities. The state of the system is defined in accordance with the continuous or discrete formulation of the variables which describe the groundwater flow model in time and space. Groundwater movement is often described by equations based on Darcy's law and the equation of continuity. These equations contain a number of lumped parameters, representing the properties of the soil. These parameters are not known and have to be estimated from field measurements (eg, pumping tests) or from calculations. Groundwater movement can be described by one lumped parameter; two algorithms were developed to estimate that parameter based upon an optimal-state estimation with a standard Kalman filter algorithm. In both methods, existing series of groundwater levels/piezometric levels can be used. The two algorithms were applied to an example with generated data. The estimation methods may be extended to cases with more than one parameter. Both methods allow insight in the variance of the parameter and in the reliability of the calculation results of the hydrological model. (Collier-IVI)
W86-00044

**ALTERNATING DIRECTION GALERKIN TECHNIQUE FOR SIMULATION OF CONTAMINANT TRANSPORT IN COMPLEX GROUNDWATER SYSTEMS,**

Waterloo Univ. (Ontario). Dept. of Earth Sciences.
For primary bibliographic entry see Field 5B.
W86-00072

**ANALYSIS AND INTERPRETATION OF SINGLE-WELL TRACER TESTS IN STRATIFIED AQUIFERS,**

Auburn Univ., AL. Dept. of Civil Engineering.
O. Guven, R. W. Falta, F. J. Molz, and J. G. Melville.
Water Resources Research, Vol. 21, No. 5, p 676-684, May, 1985. 18 Fig, 22 Ref.

Descriptors: *Aquifer testing, *Advection, *Dispersion, Tracers, Model studies, Mathematical equations, Contamination, Path of pollutants, Groundwater pollution.

The definition and measurement of the dispersive properties of a stratified aquifer are investigated based on the single-well tracer test. In the single well test, tracer is pumped into the formation for a period of time and then pumped out. Concentration data are obtained from the injection-withdrawal well and from one or more sampling observation wells which may be multilevel. The analysis of such a test is based on a Lagrangian-Eulerian numerical model which considers the depth-dependent advection in the radial direction and local hydrodynamic dispersion in the vertical and radial directions. The movement of an injected tracer in a stratified aquifer may be accurately simulated without resorting to the use of a scale-dependent, full aquifer dispersivity if the flow field is known in sufficient detail. When the advection process is simulated accurately, the values of local dispersivity will be small, constant, and on the order of those measured in the field or lab at individual levels in the aquifer. The full aquifer breakthrough curves measured in observation wells in a single well test in a stratified aquifer are determined by the hydraulic conductivity profile in the region between the injection withdrawal well and the observation well if the travel distance between these wells is typical of most test geometries. The relative concentration versus time data recorded at the injection withdrawal well during the withdrawal phase is primarily a measure of mixing in the aquifer due to local dispersion which has taken place during the experiment. The amount of mixing will depend on both the hydraulic conductivity distribution in the aquifer and the size of the experiment. As the experiment scale increases, the effects of local vertical dispersion will become larger compared to the effects of local radial dispersion. Local vertical dispersion will cause solute traveling in a high conductivity layer in an aquifer to migrate into adjacent low-conductivity layers where its movement will be relatively slow in comparison. In the initial design of a tracer test it is important to have some idea of the type of nonhomogeneity which is present. More information of a broad nature concerning the types or classifications of nonhomogeneities that exist in natural aquifers is needed. (Baker-IVI)
W86-00074

**STRATIGRAPHY AND SEDIMENTARY FACIES OF THE MADISON LIMESTONE AND ASSOCIATED ROCKS IN PARTS OF MONTANA, NEBRASKA, NORTH DAKOTA, SOUTH DAKOTA, WYOMING,**

Geological Survey, Rolla, MO. Water Resources Div.
J. A. Peterson.
Available from the Distr. Br., USGS, 604 So. Pickett St., Alexandria, VA 22304. USGS Professional Paper 1273-A, 1984. 83 p, 34 Fig, 2 Tab, 88 Ref.

Descriptors: *Stratigraphy, *Hydrogeology, *Aquifers, Geologic units, Facies (Sedimentary), *Carbonate rocks, *Groundwater resources, *Sedimentary basins (Geologic), Permeability, *Madison Limestone, Paleogeography, Paleostructure, *Marker Beds, Reefs, *Carbonate Mounds, Montana, North Dakota, South Dakota, Wyoming, Nebraska.

The Madison Limestone study was begun in 1976 to evaluate the Madison Limestone and associated rocks as possible sources of water for the development of coal resources in the Northern Great Plains. Paleozoic sedimentary rocks in this area include a sequence of mostly shallow-water marine carbonate, clastic, and evaporite deposits of Middle Cambrian through Late Permian age. Upper Ordovician through Upper Mississippian rocks are primarily carbonate beds containing porous units, mainly dolomite or dolomitic limestone, which are widespread but discontinuous. The Devonian and Mississippian sediments are cyclic deposits, and the Mississippian carbonate rocks can be divided into at least 13 carbonate-evaporite marker-defined cyclic units, based on the common occurrence of shaly marker beds, identified on geophysical logs. The Upper Paleozoic rocks are dominated by clastic rocks, beginning with the marine shales, carbonates, redbeds and evaporites of the Upper Mississippian and ending with the relatively thick marine and aeolian sandstones, red beds, and evaporites of Pennsylvanian and Permian age. Thick, porous sandstone beds occur in Upper Pennsylvanian and Lower Permian rocks of Wyoming, southeastern Montana, northwestern South Dakota, and southwestern North Dakota. (USGS)
W86-00104

**ANALYSIS AND INTERPRETATION OF DATA OBTAINED IN TESTS OF THE GEOTHERMAL AQUIFER AT KLAMATH FALLS, OREGON,**
Geological Survey, Menlo Park, CA. Water Resources Div.
E. A. Sammel.
Available from the OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigation Report 84-4216, 1984. 151 p, 65 Fig, 7 Tab, 68 Ref.

Descriptors: *Hydrogeology, *Reconnaissance, *Geothermal resource, Evaluation, Geology, *Oregon, Klamath County, Klamath Falls.

Water with temperatures to 130 C occurs in an extensive, heterogeneous aquifer at depths of a few hundred to nearly 2,000 feet. Chemical and isotopic analyses suggest that 190 C water mixes with cooler recharge water in a ratio of about 2 to 3 in zone within and beneath the aquifer. The water spreads from a fault zone and is tapped for space heating by more than 450 wells over a 2 square-mile area. Data obtained during a 50-day pumping and reinjection test in July and August, 1983, were fitted to theoretical double-porosity type curves. Predictions of water-level changes were made for two hypothetical pumping and reinjection schemes. It was determined that reinjection can generally offset declines due to pumping, although water levels will decline near pumped wells and will rise near injection wells. Tracer tests confirmed the double-porosity behavior of the aquifer. Discharge from thermal wells averages about 540 gallons per minute and heat discharge is about 18 x 10 to the 12th power British Thermal Units per year. Down-hole heat exchangers discharge about 13 x 10 to the 10th power British Thermal Units per year. Additional development probably is feasible. (USGS)
W86-00107

**WATER RESOURCES ON THE PUEBLO OF LAGUNA, WEST-CENTRAL NEW MEXICO,**
Geological Survey, Albuquerque, NM. Water Resources Div.
D. W. Risser, and F. P. Lyford.
Available from the OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigation Report 83-4038, 1983. 308 p, 42 Fig, 17 Tab, 45 Ref.

Descriptors: *Groundwater availability, *Surface water availability, *Groundwater movement, *Water quality, Computer modeling, *Aquifer testing, Pueblo of Laguna, *New Mexico, Bernalillo, Sandoval County, Valencia County, Cibola County, Rio San Jose Basin.

This study evaluates the quality and quantity of water available on the Pueblo of Laguna, New Mexico. Groundwater for public supply occurs in the valley fill along the Rio San Jose, in the Paguate and Encinal areas, and possibly in the northern part of the Sedillo Grant. The valley fill in the Rio San Jose will supply 50 to 450 gallons per minute of potable water to properly constructed wells. In the alluvium along Rio Paguate, additional development of as much as 250 gallons per minute is possible. Groundwater for irrigation is restricted by available yields and quality to the valley fill along the Rio San Jose and possibly the western part of the Major's Ranch area. In the Rio San Jose valley yields of 50 to 450 gallons per minute of water containing 500 to 3,000 milligrams per liter are possible. Digital-model simulations of the valley-fill aquifer west of the Village of Laguna show a potential salvage of as much as 900 acre-feet per year of evapotranspiration losses if water levels are lowered. Model studies also indicate that the winter flow of the Rio San Jose could be used to recharge groundwater stored in the valley. (USGS)
W86-00108

**GROUND-WATER RESOURCES OF AUDRAIN COUNTY, MISSOURI,**
Geological Survey, Rolla, MO. Water Resources Div.
L. F. Emmett, and J. L. Imes.
Available from the OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Open-File Report 84-245, 1984. 55 p, 38 Fig, 8 Tab, 34 Ref.

Descriptors: *Computer model, *Groundwater movement, Groundwater irrigation, *Drawdown, *Potentiometric surface, Wells, Water supply, Groundwater availability, *Missouri, Audrain County, Enroachment, Water use, Water quality, Consolidated aquifer.

The deep (principal) aquifer in Audrain County has an average thickness of about 1,300 feet and is composed of dolomite and minor quantities of sandstone of Cambrian and Ordovician age. The deep aquifer is the source of water for all public-supply and irrigation wells in Audrain County. Pumpage from the deep aquifer has caused a decrease in hydraulic head of more than 200 feet since 1900 in the vicinity of the city of Mexico. Calculations from a two-dimensional digital model of the deep aquifer indicate that the drawdown would increase 10 to 25 feet from May 1979 levels in Audrain County by May 2000 in the absence of irrigation pumpage and if public-supply wells continue to pump at the 1980 rate. If the additional stress due to seasonal irrigation is continued at 1980 pumping rates, 60 +/- 20 feet of drawdown is predicted by May 2000. Audrain County is the northernmost extent of freshwater in this aquifer in Missouri. In Audrain County the dissolved-solids concentration of water from this aquifer varies from 1,200 milligrams per liter in the north to less than 400 milligrams per liter in the south. Lowered water levels in the aquifer may allow water with a larger dissolved-solids concentration to move into the area. (USGS)
W86-00113

**WATER TABLE IN ROCKS OF CENOZOIC AND PALEOZOIC AGE, 1980, YUCCA FLAT, NEVADA TEST SITE, NEVADA,**
Geological Survey, Lakewood, CO. Water Resources Div.
G. C. Doty, and W. Thordarson.
Available from the OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigation Report 83-4067, 1983. 1 p (cover), 1 Fig (map).

Descriptors: *Water table, *Maps, *Nevada, Groundwater resources, Hydrogeology, Yucca Flat, Nevada Test Site, *Nye County.

The water table at Yucca Flat, Nevada Test Site, Nevada, occurs in rocks of Paleozoic age and in tuffs and alluvium of Cenozoic age and ranges in altitude from about 2,425 feet to about 3,500 feet. The configuration of the water table is depicted by contours with intervals of 25 to 500 feet. Control for the map consists of water-level information from 61 drill holes, whose locations and age of geologic units penetrated are shown by symbols on the map. (USGS)
W86-00116

**GROUND-WATER CONDITIONS IN THE COTTONWOOD-WEST OAKLEY FAN AREA, SOUTH-CENTRAL IDAHO,**
Geological Survey, Boise, ID. Water Resources Div.
T. K. Edwards, and H. W. Young.
Available from the OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigation Report 84-4140, 1984. 32 p, 12 Fig, 3 Tabs, 22 Ref.

Descriptors: *Groundwater development, *Water table decline, *Groundwater depletion, Groundwater barriers, *Aquifer testing, *Overdraft, *Idaho, Golden Valley, Cottonwood-West Oakley Fan, Rock Creek Hills, Critical Groundwater Area.

Intensive groundwater development in the Cottonwood-West Oakley Fan area, Cassia County, Idaho, has resulted in rapid water-level declines and establishment of two critical groundwater areas. A northwest-trending fault in nearly coincident with the boundary between the two critical groundwater areas. Southwest of the fault, water levels in limestone are as much as 200 feet higher than those in silicic volcanics northeast of the fault, which indicates the fault is an effective barrier to groundwater movement. Results of an aquifer test in limestone southwest of the fault further indicate no hydraulic connection with the silicic volcanics aquifer northeast of the fault. Water levels in wells completed in limestone and silicic volcanics aquifers have declined 5 and 5.5 feet per year since 1977. Groundwater withdrawals in 1980 were about 60,000 acre-free from the silicic volcanics aquifer and, between 1977 and 1982, averaged about 5,300 acre-feet per year from the limestone aquifer. Annual recharge to the silicic volcanics aquifer is between about 10,000 and 26,000 acre-feet; recharge to the limestone aquifer is near 4,000 acre-feet. Limited water-quality data indicate the groundwater is chemically suitable for irrigation and domestic use. (USGS)
W86-00117

**STREAMFLOW LOSSES ALONG THE BALCONES FAULT ZONE, NUECES RIVER BASIN, TEXAS,**
Geological Survey, Austin, TX. Water Resources Div.
For primary bibliographic entry see Field 2E.
W86-00124

**AVAILABILITY OF WATER FROM THE ALLUVIAL AQUIFER IN PART OF THE GREEN RIVER VALLEY, KING COUNTY, WASHINGTON,**
Geological Survey, Tacoma, WA. Water Resources Div.
W. E. Lum, II, R. C. Alvord, and B. W. Drost.
Available from the OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigation Report 83-4178, 1984. 38 p, 12 Fig, 4 Tab, 5 Ref.

Descriptors: *Computer model, Groundwater availability, *Groundwater, *Well yield, Water resources development, Streamflow depletion, *Surface-groundwater relationships, Potential water supply, *Alluvial aquifers, Green River, King County, *Washington.

The Muckleshoot Indian Tribe plans (1982) to build a fish hatchery in part of a 1.56-square-mile area in the Green River valley, Washington, and use groundwater to operate it. Groundwater data

were collected in the area and used in a U.S. Geological Survey two-dimensional groundwater-flow model calibrated to simulate the groundwater-flow system in the study area. Measured water levels in the alluvial aquifer were simulated to within 1 foot at 7 of 12 observation wells, and within 2 feet at all 12 wells. When pumping from the aquifer was simulated with the model, it was found that all water pumped from wells was derived from induced leakage from the Green River into the alluvium and reduced leakage through the alluvium to the Green River. Pumping from the alluvium may also reduce the flow of a tributary to the Green River. (USGS)
W86-00126

**WATER RESOURCES DATA FOR FLORIDA, WATER YEAR 1981 VOLUME 1: NORTHEAST FLORIDA.**
Geological Survey, Orlando, FL. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-00127

**WATER RESOURCES DATA FOR COLORADO, WATER YEAR 1982, VOLUME 2. COLORADO RIVER BASIN ABOVE DOLORES RIVER,**
Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-00128

**WATER RESOURCES DATA HAWAII, OTHER PACIFIC AREAS, WATER YEAR 1981. VOLUME 2. GUAM, NORTHERN MARIANA ISLANDS, FEDERATED STATES OF MICRONESIA, PALAU ISLANDS AND AMERICAN SAMOA.**
Geological Survey, Honolulu, HI. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-00130

**NATURAL GROUND-WATER-RECHARGE DATA FROM THREE SELECTED SITES IN HARVEY COUNTY, SOUTH-CENTRAL KANSAS,**
Geological Survey, Lawrence, KS. Water Resources Div.
C. A. Perry.
Available from the OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Open-File Report 84-457, 1984. 31 p, 7 Fig, 7 Tab, 4 Ref.

Descriptors: *Data collections, Soil water, *Groundwater level, Rainfall, *Recharge, *Kansas, Equus beds, Recharge data.

The cities of Wichita, Newton, and several smaller towns pump large quantities of water from the 'Equus Beds' aquifer in south-central Kansas. The aquifer also supplies large quantities of water for irrigation at a steadily increasing rate. The Harvey County Planning and Zoning Commission entered into a cooperative agreement with the U.S. Geological Survey to collect information on natural recharge at three sites having different soils and unsaturated lithologies. Data summarized in tabular form include daily rainfall amounts, average soil moisture for selected layers, water-table levels, and neutron-measured soil moisture at 1-foot intervals. This information can be used in studying the possibility of protecting the aquifer from any development that might impede natural recharge. (USGS)
W86-00132

**USER'S GUIDE FOR A PLANE AND AXISYMMETRIC FINITE ELEMENT PROGRAM FOR STEADY-STATE SEEPAGE PROBLEMS,**
Army Engineer Waterways Experiment Station, Vicksburg, MS. Automatic Data Processing Center.
For primary bibliographic entry see Field 2G.
W86-00156

**PUBLIC WATER SUPPLIES IN GLOUCESTER COUNTY, N.J.,**
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
W. F. Hardt.
Water Resources Circular No. 9, New Jersey State Dept. of Conservation and Economic Development, 1963. 55 p, 4 Fig, 5 Tab, 8 Ref.

Descriptors: *Municipal water, *Water supply, *Water demand, *Water use, *Potential water supply, Water quality, Groundwater, Water conveyance, Aquifers, Geohydrology, Pumping plants, Saline water intrusion.

Gloucester County is part of the Lower Delaware River Valley in New Jersey. This area is attracting new industry and has shown a population increase of about 47% from 1950-1960. The availability and quality of water is becoming more important with the economic growth of the county. Gloucester County is underlain by unconsolidated sands and clays of Quaternary, Tertiary, and Cretaceous age. The Raritan and Magothy Formations constitute the most important aquifers and yield more than 95% of the water pumped by the public water systems in the county. These formations are capable of yielding 1,400 gallons per minute (gpm) or more to large diameter wells. The overall chemical quality of the groundwater is good. Contamination of groundwater by salt-water encroachment or by pollution from industrial activity or organic waste in densely populated areas should be prevented. The 21 public water systems in Gloucester County realized 100% increase in pumped water from 1948 to 1959. The history of the present installations, groundwater conditions, quality and availability of water, and potential future yield for the 21 public water systems in Gloucester County are summarized.
W86-00174

**SEEPAGE ANALYSIS USING THE BOUNDARY ELEMENT METHOD,**
Bureau of Reclamation, Denver, CO. Engineering and Research Center.
For primary bibliographic entry see Field 2G.
W86-00228

## 2G. Water In Soils

**SOIL MOISTURE CONTENT: STATISTICAL ESTIMATION OF ITS PROBABILITY DISTRIBUTION,**
Kozponti Meteorologiai Intezet, Budapest (Hungary).
T. Farago.
Journal of Climate and Applied Meteorology, Vol. 24, No. 4, p 371-376, April, 1985. 3 Fig, 29 Ref.

Descriptors: *Soil water, *Statistical analysis, *Precipitation, Surface water, Markov process, Mathematical studies, Meteorology.

The simplified surface-water balance equation was generalized so as to express the probability distribution of its soil moisture component in a recurrence form; an extended probability model for soil moisture was derived based on a chain-dependent model for precipitation. A similar equation was deduced for the first moments as well. The consideration of the stochastic dependence of the consecutive daily precipitation amounts is usually unavoidable for periods essentially shorter than one month. Gamma distributions were used in fitting the stochastic variables of daily precipitaiton amounts. The model could have been solved only in an approximate numerical way due to its complexity. Nevertheless, either the distribution function, or, in a simpler case, the mean value of soil moisture can effectively be estimated given all parameters of the Markov process of daily precipitation, an initial value of the soil moisture and the coefficient of parameterization of other terms in the water balance equation. Such a parameterization is acceptable under the conditions of insufficient humidification. The model is illustrated by a numerical example. (Collier-IVI)
W86-00021

**BLOCK-GEOMETRY FUNCTIONS CHARACTERIZING TRANSPORT IN DENSELY FISSURED MEDIA,**
British Geological Survey, Wallingford (England).
For primary bibliographic entry see Field 2F.
W86-00039

**COMPARING THE PERFORMANCE OF ROOT-WATER-UPTAKE MODELS,**
Katholieke Univ. Leuven (Belgium). Lab. of Soil Physics.
For primary bibliographic entry see Field 2D.
W86-00048

**INFILTRATION UNDER PONDED CONDITIONS: 1. OPTIMAL ANALYTICAL SOLUTION AND COMPARISON WITH EXPERIMENTAL OBSERVATIONS,**
Griffith Univ., Nathan (Australia). School of Australian Environmental Studies.
J. Y. Parlange, R. Haverkamp, and J. Touma.
Soil Science, Vol. 139, No. 4, p 305-311, April, 1985. 4 Fig, 13 Ref.

Descriptors: *Infiltration, *Ponding, *Mathematical equations, Water depth, Numerical analysis, Soil water, Differential equations, Mathematical studies.

Under ponded infiltration the cumulative infiltration is a function of soil properties, initial conditions, and water layer thickness above the soil surface. A simple analytical infiltration formula predicted the cumulative infiltration as a function of time when the soil surface is ponded. For arbitrary soil properties and arbitrary dependence of water layer thickness on time but uniform initial water content, the optimization technique predicts the cumulative infiltration from the integration of an ordinary differential equation. If the thickness of the water layer is constant with time, integration of the differential equation yields a fully analytical result. When the water layer thickness is small, the infiltration rate is significantly different from the standard Green and Ampt result; as the layer thickness increases, the Green and Ampt result becomes increasingly accurate. Comparison with a laboratory infiltration experiment illustrated the validity of the present infiltration expressions. (Collier-IVI)
W86-00049

**SOIL WATER EVAPORATION SUPPRESSION BY SAND MULCHES,**
Iowa State Univ., Ames. Dept. of Agronomy.
A. S. Modaihsh, R. Horton, and D. Kirkham.
Soil Science, Vol. 139, No. 4, p 357-361, April, 1985. 4 Fig, 11 Ref.

Descriptors: *Soil water, *Evaporation, *Mulches, *Sand mulch, Mulching, Evapotranspiration control, Crop production.

Experiments were performed to study sand as a soil mulch with the objective of determining the comparative effectiveness of 0-, 2-, and 6-cm-thick covering sand layers in suppressing evaporation from columns of soil. Measurements were made by using potential evaporation rates of 1.1 and 0.55 cm/d. In addition to evaporation, soil water distribution with depth was measured for the different sand-cover treatments. Five treatments were studied: check (no sand mulch), 6 cm of coarse sand (C6), 6 cm of fine sand (F6), 2 cm of coarse sand (C2), and 2 cm of fine sand (F2). After 35 d of experiment, the cumulative evaporations for the check, C6, F6, C2, and F2 treatments were measured as 6.79, 1.50, 1.55, 3.76, and 4.62 cm of water, respectively, at a potential evaporation of 1.1 cm/d and, for the potential evaporation of 0.55 cm/d, was correspondingly 6.68, 0.95, 1.21, 2.71, and 4.28 cm. These sets of numbers show that there was marked evaporation reduction for the sand mulches with respect to bare soil (check). The 6-cm sand mulches were the most effective evaporation suppressors. For equal mulch thickness, coarse sand was only slightly more effective than fine sand. Results from soil water distributions with depth for the various treatments also indicated that

the sand mulches were effective in conserving soil water against evaporation losses. The mulches were effective in this order: C6 > F6 > C2 > F2. (Author's abstract)
W86-00050

NUMERICAL CALCULATION OF SATURATED-UNSATURATED INFILTRATION IN A CRACKED SOIL,
Commonwealth Scientific and Industrial Research Organization, North Ryde (Australia). Div. of Mineral Physics.
M. R. Davidson.
Water Resources Research, Vol. 21, No. 5, p 709-714, May, 1985. 6 Fig, 14 Ref.

Descriptors: *Infiltration, *Soil water, Saturated flow, Unsaturated flow, Rainfall, Runoff, Mathematical equations, Wetting.

Infiltration in a nonswelling homogeneous soil containing regularly spaced, water filled, vertical cracks is calculated from a finite difference solution of the saturated-unsaturated flow equations. The numerical scheme is implicit with iteration based on the linear method of successive overrelaxation and uses a correction technique to prevent the accumulation of small iteration errors with time. Results agree well with those derived from a Green-Ampt model. Differences in cumulative infiltration and infiltration rates, expressed as percentages of the corresponding finite difference solution, are usually no more than about 4% and can be much less. Calculations predict that when the magnitude of the moisture potential at the wetting front in low, the persistence of mushrooming of wetted tongues moving out of adjacent cracks results in the formation of an unwetted pocket centered on the line of symmetry when the crack spacing depth ratio is also small. As the pocket fills the infiltration rate exhibits a sudden drop caused by a corresponding rapid fall in lateral potential gradients. As moisture potential at the wetting front becomes more negative, the depth of penetration by the zone of positive presssure decreases, although penetration by the wetting front increases. (Baker-IVI)
W86-00078

EVALUATION OF HYDROLOGIC PROCESSES AFFECTING SOIL MOVEMENT IN THE HAGERMAN FAUNA AREA, HAGERMAN, IDAHO,
Geological Survey, Boise, ID. Water Resources Div.
H. W. Young.
Available from the OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigation Report 84-4137, 1984. 17 p, 4 Fig, 1 Tab, 2 Ref.

Descriptors: Soil stability, *Erosion, *Perched ground water, Springs, *Agricultural runoff, *Seepage loss, Erosion control, *Idaho, Hagerman fossil beds.

The Hagerman fauna area on the western slope of the Snake River canyon in south-central Idaho is one of the most important locations of upper Pliocene fossils in the world. The fossil beds are distributed vertically through a 500-foot stratigraphic section of the Glenns Ferry Formation. Accelerated soil movement caused by surface-water runoff from irrigated farmlands on the plateau above the canyon and discharge from springs and seeps along the slope of the canyon is eroding the fossil beds. Source of the springs and seeps is a perched aquifer, which is probably recharged by seepage losses from two irrigation canals that head near the canyon rim. Annual canal losses are about 1,900 acre-feet. Annual discharge from springs and seeps is about 420 acre-feet. Corrective measures that could be taken to stabilize the soil movement and preserve the fauna area include: (1) Lining or treating the canals, (2) eliminating the practice of flushing irrigation systems, (3) constructing road berms and cross dips, and (4) establishing an uncultivated strip of land between irrigated farmlands and the canyon rim. (USGS)
W86-00119

USER'S GUIDE FOR A PLANE AND AXISYMMETRIC FINITE ELEMENT PROGRAM FOR STEADY-STATE SEEPAGE PROBLEMS,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Automatic Data Processing Center.
F. T. Tracy.
Instruction Report K-83-4, September 1983. Final Report. 58 p, 21 Fig, 1 Append.

Descriptors: *Seepage, *Computer programs, *Mathematical models, Finite element method, Laminar flows, Laplace equation, Darcy's Law, Soil water movement, Groundwater movement.

This report is a user's guide for a plane and axisymmetric finite element method (FEM) computer program for solving steady-state seepage problems. Confined or unconfined, homogeneous or nonhomogeneous, and isotropic or anisotropic problems can be solved. Laplace's Equation and Darcy's Law, the equations governing laminar flow through porous media, are the basis for the analysis. Input to the program consists basically of permeability data, node data, and element data. Output from the program consists of heads at the nodes, discharge velocities at the element centers, and a postprocessor file. For unconfined problems, a description of the resulting phreatic surface is also given. The report also contains some sample problems and a brief description of the theory. (Author)
W86-00156

SEEPAGE ANALYSIS USING THE BOUNDARY ELEMENT METHOD,
Bureau of Reclamation, Denver, CO. Engineering and Research Center.
A. K. Chugh, and H. T. Falvey.
REC-ERC-83-11, May 1984. 55 p, 15 Fig, 3 Tab, 18 Ref, Append.

Descriptors: *Groundwater movement, *Seepage, *Soil water movement, *Infiltration, Computer models, Model studies, *Mathematical models, Steady flow, Dams, Foundations, Boundary conditions, Boundary element method, Anisotropy.

A simple and effective extension of the boundary element method for solving basic equation of steady flow in isotropic soil is presented to solve steady confined or steady unconfined flow problems or both in zoned anisotropic mediums. A computer program listing in FORTRAN IV and a set of user's instructions are included to facilitate the use of the computer program. Only steady-state seepage problems in two-dimensional domains with general distribution of piecewise homogeneous material zones are considered. Sample problems illustrating the use of the computer program and the accuracy of results are given. (Author)
W86-00228

## 2H. Lakes

SEASONAL SUCCESSION OF PHYTOPLANKTON IN LAKE CONSTANCE,
Konstanz Univ. (Germany, F.R.). Limnological Inst.
U. Sommer.
BioScience, Vol. 35, No. 6, p 351-357, June, 1985. 3 Fig, 49 Ref.

Descriptors: *Seasonal variation, *Succession, *Phytoplankton, *Lake Constance, *Austria, *Switzerland, *West Germany, Stratification, Physicochemical properties, Species composition, Mixing, Destratification.

Phytoplankton succession, the physical and chemical environment, photosynthesis, zooplankton production and population dynamics, bacterio-plankton, and algal sedimentation were studied between 1979 and 1982 on Lake Constance (West Germany, Austria, and Switzerland) and phytoplankton nutrient competition was studied in steady-state and pulsed-state systems. The results of these studies were reviewed in an analysis of the relative importance of temperature, stratification, light, competition for resources, sedimentation, and losses to heterotrophic compartments of the trophic chain in controlling seasonal shifts in phytoplankton species composition and how the importance of those factors varies during the year. In Lake Constance, the phytoplankton growth season starts when stratification begins in spring. The seasonal pattern of stratification and mixing is the master environmental variable in deep lakes like Lake Constance. Temperature and sedimentation turn out to be less important in succession than traditionally assumed. Initially, maximum growth rates are favored; later, as the water column stabilizes, zooplankton grazing and competition for nutrients become the dominant selective forces. When the mixing depth increases in autumn, algae that can tolerate low light are selected for. During the mixing period in winter, significant algal growth is impossible, the organisms become scarce, most nutrients remain unconsumed in solution, the water becomes highly transparent, and grazing and competition play no role. Shifts in species composition are caused by long-term, regular losses of water column stability, such as the autumn increase in mixing depth. (Collier-IVI)
W86-00051

GROUNDWATER SEEPAGE NUTRIENT LOADING IN A FLORIDA LAKE,
Florida Inst. of Tech., Melbourne. Dept. of Environmental Sciences and Engineering.
T. V. Belanger, D. F. Mikutel, and P. A. Churchill.
Water Research, Vol. 19, No. 6, p 773-781, 1985. 3 Fig, 9 Tab, 20 Ref.

Descriptors: *Groundwater movement, *Nutrient loading, *East Lake Tohopekaliga, *Florida, *Seepage, Lakes, Water quality, Piezometers, Seepage meters, Hydrologic budget.

Twenty-five seepage meters were positioned in East Lake Tohopekaliga, Florida, to determine groundwater seepage contributions of water and nutrients to the lake in 1983. Seepage was found to be an important source of water to the lake, contributing 14.3% of the water sources, and rates decreased significantly ($P < 0.01$) with distance from shore. A comparison of the piezometer and seepage meter techniques for measuring nutrient loading to the lake indicates the direct seepage meter technique overestimated nutrient inputs due to the enclosure to the sediments, possibly resulting in anaerobic conditions and increased release rates of ammonium nitrogen and phosphate. These results suggest that past studies employing this technique may be in error. Nutrient loading, calculated from piezometer nutrient data and seepage meter flow data, show that the groundwater nutrient loading in the lake was significant, contributing 8.7 and 17.6% of the total phosphorus and total nitrogen inputs to the lake, respectively. (Author's abstract)
W86-00065

UNIFIED THEORY FOR MICROBIAL GROWTH UNDER MULTIPLE NUTRIENT LIMITATION,
Wisconsin Univ.-Milwaukee. Dept. of Civil Engineering.
C. Y. Chen, and E. R. Christensen.
Water Research, Vol. 19, No. 6, p 791-798, 1985. 6 Fig, 2 Tab, 17 Ref. U.S. NSF grant CEE 8103650.

Descriptors: *Microbial growth models, *Limiting nutrients, *Model studies, Threshold models, Product models, Growth kinetics, Growth rates.

A unified theory for microbial growth under multiple nutrient limitation is presented. The theory has a probabilistic foundation and gives the well-known threshold and product models as special cases. The threshold model is obtained for full correlation of cell division activation levels which would occur for a single species from a single clone, growing synchronously. In contrast, the product model applies to zero correlation of the activation levels which is likely to be found in a mixed culture. The growth kinetics for each limiting nutrient acting separately, while others are at saturation, can be any of the well-known types;

e.g. Monod or exponential, or the more general logit (Moser) and Weibull models. The Weibull model is given a novel probabilistic basis. (Author's abstract)
W86-00067

**NITROGEN AND PHOSPHORUS SPECIATION AND FLUX IN A LARGE FLORIDA RIVER WETLAND SYSTEM,**
Geological Survey, Tallahassee, FL.
J. F. Elder.
Water Resources Research Vol.21, No. 5, p 724-732, May, 1985. 7 Fig, 4 Tab, 51 Ref.

Descriptors: *Wetlands, *Florida, *Apalachicola River, *Nitrogen, *Phosphorus, Nutrients, Suspended sediments, Chemical speciation, Dissolved solids, Nitrates, Particulate matter, Organic compounds.

Nutrient flux was examined in a river wetland system in northern Florida, the Apalachicola River system. The nutrient species differed substantially in the amount of net import or export from the Apalachicola River wetland system. The changes in TN and NO3-N were within the expected error of estimate, and therefore the system cannot be considered either a source or a sink for total or nitrate nitrogen. Significant net changes did occur for other nitrogen species. The system showed a distinct tendency to yield organic nitrogen, both dissolved and particulate, while consuming ammonia nitrogen. These counterbalancing processes are masked by investigation of total nitrogen alone. The flux of ammonia nitrogen was notably different from other species. The behavior of phosphorus was similar to that of nitrogen. Soluble reactive phosphorus decreased, indicating consumption within the system, whereas the remaining dissolved phosphorus showed a net yield. There appeared to be a net yield of particulate and total phosphorus, but the percent changes were barely above errors of estimate. The soluble reactive phosphorus (SRP) budget was similar to that of NH4-N. Import within the system was evident, and the loads at the headwaters and mouth of the river were nearly equal. Input by precipitation was also a significant source of SRP, approaching 10% of the total outflow. For all nitrogen and phosphorus species the predominant source was inflow from the upper watershed near Chattahoochee. The Chipola River was the second major contributor for most species. Groundwater, precipitation, and surface water runoff contributed only a small portion of the total riverine nutrient load. The relative errors of estimate of these components are larger than those of the riverine components, but the overall budget is not appreciably affected by error factors associated with small components. (Baker-IVI)
W86-00080

**HISTORICAL CHANGES TO LAKE WASHINGTON AND ROUTE OF THE LAKE WASHINGTON SHIP CANAL, KING COUNTY, WASHINGTON,**
Geological Survey, Seattle, WA. Water Resources Div.
M. J. Chrzastowski.
USGS Water-Resources Investigation Report 81-1182, 1983. 39 p, 6 Fig, 1 Tab, 41 Ref.

Descriptors: *Historical shoreline, *Shorelines, *Wetlands, *Shoreline changes, *Canals, Stream loss, Landfill, Land-use planning, Stream diversions, Lakes, Lake hydrology, Maps, *Washington, Seattle, *Lake Washington, Lake Washington Ship Canal, Lake Union, Salmon Bay, Sammamish River, Cedar River, Black River, Duwamish River, Renton, Ballard, Hiram M. Chittenden Locks, Shilshole Bay.

Historical shoreline changes to hydrologic characteristics were studied for Lake Washington and the route of Lake Washington Ship Canal. The study is based on comparison of maps made during the period 1875-1907 and modern topographic maps, supplemented with historical documents that describe the once-natural setting of the lakes and streams in the Lake Washington drainage basin. The observed shoreline changes range from minor to substantial. The water-surface area has been historically reduced by about 6 square kilometers, and total shoreline has been reduced by 20 kilometers. Approximately 4 square kilometers of the historical wetland area has been eliminated, or about 93 percent of the natural wetland extent. The changes have resulted from construction of the Lake Washington Ship Canal and accompanying water-level adjustments, shoreline modification from urban growth of the area, and limited natural processes. The map comparison documents (1) extent of shoreline changes (2) historical loss of wetlands area, (3) loss of small streams that historically entered the lakes and bays, and (4) historical vegetation and land-use patterns around the lakeshore and canal route. The identification of historical shorelines, wetlands, and small streams that have no expression on today's landscape is information of value to land-use planning and local engineering activities. (USGS)
W86-00105

**PRELIMINARY EVALUATION OF LAKE SUSCEPTIBILITY TO WATER-QUALITY DEGRADATION BY RECREATIONAL USE, ALPINE LAKES WILDERNESS AREA, WASHINGTON,**
Geological Survey, Seattle, WA. Water Resources Div.
For primary bibliographic entry see Field 5C.
W86-00114

**COEFFICIENTS FOR USE IN THE U.S. ARMY CORPS OF ENGINEERS RESERVOIR MODEL, CE-QUAL-R1,**
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
For primary bibliographic entry see Field 5B.
W86-00153

**LARGE-SCALE OPERATIONS MANAGEMENT TEST OF USE OF THE WHITE AMUR FOR CONTROL OF PROBLEM PLANTS: SELECTED LIFE HISTORY INFORMATION OF ANIMAL SPECIES ON LAKE CONWAY, FL,**
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
For primary bibliographic entry see Field 4A.
W86-00197

**VOLUNTEER LAKE MONITORING, 1981,**
Illinois State Environmental Protection Agency, Springfield. Div. of Water Pollution Control.
For primary bibliographic entry see Field 5C.
W86-00200

**PHYTOPLANKTON-ENVIRONMENTAL INTERACTIONS IN RESERVOIRS, VOLUME II: DISCUSSION OF WORKSHOP PAPERS AND OPEN LITERATURE,**
Tetra Tech, Inc., Bellevue, WA.
M. W. Lorenzen, D. B. Porcella, and T. M. Grieb.
Technical Report E-81-13, September 1981. Final Report. U.S. Army Environmental and Water Quality Operational Studies, Army Engineer Waterways Experiment Station, Vicksburg, MS. 104 p, 3 Fig, 10 Tab, 101 Ref. Contract/Grant No. DACW39-78-C-0088.

Descriptors: *Lake, *Reservoirs, *Phytoplankton, *Algae, *Environmental effects, *Water quality, Model studies, Mixing, Dissolved oxygen, Oxygen, Aesthetics, Trophic level, Eutrophication, Data collections, Sampling, Numerical analysis, Mathematical models, Simulation analysis, Nutrients, Grazing, Limnology, Fish, Chlorophyll, Temperature effects, Photosynthesis.

This report is a supplement to the Proceedings of the Workshop on Phytoplankton-Environmental Interactions in Reservoirs. It is organized to provide a general perspective and interpretation of the knowledge about phytoplankton behavior in reservoirs and to discuss techniques for reservoir study. Topics included are phytoplankton effects on water quality (mixing, vertical zones, and clarity; dissolved oxygen; aesthetic effects; trophic levels), techniques for reservoir study (data collection, multivariate numerical analysis, loading models, simulation models), and reservoir phytoplankton models, (utility, algal production and loss, transport, temperature, light, nutrients, grazing, typical formulations, growth and death rates, and recommended formulations).
W86-00206

**LOCATIONS AND AREAS OF PONDS AND CAROLINA BAYS AT THE SAVANNAH RIVER PLANT,**
Du Pont de Nemours (E.I.) and Co., Aiken, SC. Savannah River Lab.
J. D. Shields, N. D. Woody, A. S. Dicks, G. J. Hollod, and J. Schalles.
Available from the National Technical Information Service, Springfield, VA 22161 as DE82015381. DP-1525 (Rev. 1), May 1982. 19 p, 7 Fig, 2 Tab, 4 Ref. Contract/Grant No. DE-AC09-76SR00011.

Descriptors: *Lakes, *Ponds, *Carolina bays, Shallow water, Savannah River Plant, South Carolina.

The U.S. Department of Energy's Savannah River Plant, a 192,000-acre site in South Carolina, contains 28 ponds and 190 Carolina bays. Carolina bays are defined as elliptical depressions, usually oriented northwest-southeast, with no apparent inlet or outlet. Pat Pond, the largest pond, is 2500 acres. The mean pond area, not including Par, is 17.6 acres (range, 0.4-202.8 acres). The mean area for Carolina bays is 6.6 acres (range, 0.3-124.0 acres). Not all Carolina bays hold water; however, higher soil moisture than the surrounding land is often indicated by aquatic vegetation.
W86-00263

**PONDS AND LAGOONS OF HORN AND PETIT BOIS ISLANDS, MISSISSIPPI, GULF ISLANDS NATIONAL SEASHORE: THEIR PHYSICAL SIZE, LITERATURE REVIEW AND RECOMMENDATIONS FOR FUTURE RESEARCH,**
National Space Technology Labs., NSTL Station, MS.
S. Shabica, and J. Watkins.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-137067. National Park Service, Research/Resources Management Report SER-60, January 1982. 29 p, 3 Fig, 8 Tab, 12 Ref.

Descriptors: *Ponds, *Lagoons, *Aquatic life, Oysters, Fish, Horn Island, Petit Bois Island, Gulf Islands National Seashore, Vegetation, Brackish water, Tide lands, Mississippi.

The physical size of bodies of water on Petit Bois Island and Horn Island, Mississippi, was surveyed. Petit Bois Island contains 17 ponds and lagoons (0.17 to 18.04 hectares each) covering a total of 46.26 acres, 3.2% of the island's area. Horn Island has 63 ponds and lagoons (0.08 to 53.63 hectares each) covering a total of 191.58 acres, 5.8% of the island's area. These ponds and lagoons, all brackish, are concentrated on the eastern, geologically oldest, most stable portions of the islands. Since a 1965-1966 survey, 17 ponds on Horn Island have remained relatively stable, 12 water bodies have evolved into 5 discrete ponds, 19 water bodies ceased to exist, and 38 new water bodies have evolved into ponds. The literature on vegetation, fish, and oysters is reviewed. Recommendations for future research are made. Several of these concern aquatic life, particularly fish and oysters.
W86-00278

**WAVE DATA ACQUISITION AND HINDCAST FOR SAGINAW BAY, MICHIGAN,**
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
A. W. Garcia, and R. E. Jenssen.
Technical Report HL-83-14, June 1983. Final Report. 69 p, 31 Fig, 4 Tab, 26 Ref, 2 Append.

Descriptors: *Lakes, *Waves, *Data acquisition, Saginaw Bay, Michigan, Storms, Wave height, Model studies, Hindcast models, Wind, Lake Huron, Damage, Adsorption, Shallow water.

A wave-measurement system was deployed in Saginaw Bay, Michigan, for the purpose of determining the wave growth within the bay as functions of fetch and time. The wave data acquired provide the basis for development and verification of a shallow-water wave hindcast model. The hindcast model, along with 20 years of wind data, is used to perform and extremal analysis of wave conditions within Saginaw Bay. Results of the analysis show that a maximum significant wave height of about 8 ft is expected at the head of the bay. (Author)
W86-00282

## 2I. Water In Plants

**INTERCEPTION STORAGE CAPACITIES OF TROPICAL RAINFOREST CANOPY TREES,**
Boston Coll., Chestnut Hill, MA. Dept. of Geology and Geophysics.
S. R. Herwitz.
Journal of Hydrology, Vol. 77, p 237-252, 1985. 4 Fig, 2 Tab, 27 Ref.

Descriptors: *Interception storage, *Canopy, *Rain forests, *Trees, *Throughfall, Rainwater, Bark, Vegetation, Leaves.

The rainwater interception storage capacities of mature canopy trees in a tropical rainforest site in northeast Queensland, Australia, were approximated using a combination of field and laboratory measurements. The above-ground vegetative surfaces of five selected species (three flaky-barked; two smooth-barked) were saturated under laboratory conditions in order to establish their maximum interception storage capacities. Average leaf surface interception storages ranged from 112 to 161 ml/sq m. The interception storages of bark ranged from 0.51 to 0.97 ml/cu cm. These standardized interception storages were applied to estimates of leaf surface area and bark volume for 51 mature canopy trees representing the selected species in the field site. The average whole tree interception storage capacities of the five species ranged from 110 to 5281 per tree and 2.2 to 8.3 mm per unit projected crown area. The highly significant interspecific differences in interception storage capacity suggest that both floristic and demographic data are needed in order to accurately calculate a forest-wide interception storage capacity for species-rich tropical rainforest vegetation. Species with large woody surface areas and small projected crown areas are capable of storing the greatest depth equivalents of rainwater under heavy rainfall conditions. In the case of both the flaky-barked and the smooth-barked species, bark accounted for > 50% of the total interception storage capacity under still-air conditions, and > 80% under turbulent air conditions. The emphasis in past interception studies on the role of leaf surfaces in determining the interception storage capacity of a vegetative cover must be modified for tropical rainforests to include the storage capacity provided by the bark tissue on canopy trees. (Author's abstract)
W86-00037

**IMPACT OF WATER LEVEL CHANGES ON WOODY RIPARIAN AND WETLAND COMMUNITIES; VOLUME X: INDEX AND ADDENDUM TO VOLUMES I-VIII,**
Washington Univ., Seattle. Coll. of Forest Resources.
R. J. Chapman, and T. M. Hinckley.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-128132. FWS/OBS-82/23, July 1982. Fish and Wildlife Service, Kearneysville, WV. Eastern Energy and Land Use Team. 110 p, 20 Fig, 6 Tab, 234 Ref, 2 Append. Contract/Grant No. 14-16-0009-953.

Descriptors: *Soil-water-plant relationships, *Vegetation, *Wetlands, *Plant populations, *Water level fluctuations, Ecosystems, Riparian vegetation, Trees, Shrubs, Streams, Flooding, Environmental effects, Aquatic plants, Rivers, Water stress, Drought resistance.

This report provides the user with a summary and a general reference document for Volumes I-VIII of the Fish and Wildlife Service series on Impact of Water Level Changes on Woody Riparian and Wetland Communities. This series reviews and synthesizes existing information on the effects of water level changes on woody plants found in riparian and wetland communities. Such vegetation provides an essential component of habitat for many species of fish and wildlife throughout the United States. This index provides the reader with a summary of the earlier volumes, a list of new literature, excerpts of pertinent recent findings, and a list of errors in preceding volumes. In addition, a section on site rehabilitation has been included. (Author)
W86-00254

**IMPACT OF WATER LEVEL CHANGES ON WOODY RIPARIAN AND WETLAND COMMUNITIES; VOLUME IX: THE ALASKA REGION,**
Washington Univ., Seattle. Coll. of Forest Resources.
L. C. Lee, and T. M. Hinckley.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-128702. FWS/OBS-82-22, July 1982. Fish and Wildlife Services, Kearneysville, WV. Eastern Energy and Land Use Team. 213 p, 28 Fig, 27 Tab, 156 Ref, Append. Contract/Grant No. 14-16-0009-953.

Descriptors: *Soil-water-plant relationships, *Vegetation, *Wetlands, *Plant populations, *Water level fluctuations, Ecosystems, Riparian vegetation, Trees, Shrubs, Streams, Flooding, Environmental effects, Literature review, Cold regions, Tundra, Bogs, Marshes, Swamps, Aquatic plants, Permafrost, Muskeg, Fens, Arctic, Rivers, Water stress.

Literature on wetland and riparian plant communities in Alaska is reviewed for the purposes of planning and land management. Woody plants, perennial graminoids, and many herbaceous species are included. Detailed species lists are provided for three primary divisions (tundra, subarctic, and marine) and six provinces (Arctic tundra, Brooks Range, Bering tundra, Alaska range, Yukon forest, Pacific forest). A section on species tolerance to inundation is provided. Guidelines pertaining to other ecoregions of the U.S. are not applicable to the Alaska region because of unique conditions of cold temperature, high dissolved oxygen concentrations, low plant demand for oxygen, and nitrogen-deficient soils. The appendix lists all the plants believed to occur in Alaskan wetlands.
W86-00292

## 2J. Erosion and Sedimentation

**TRANSPORT OF SUSPENDED MATERIAL IN OPEN AND SUBMERGED STREAMS,**
Technical Univ. of Denmark, Lyngby. Inst. of Hydrodynamics and Hydraulic Engineering.
R. Wiuff.
Journal of Hydraulic Engineering, Vol. 111, No. 5, p 774-792, May, 1985. 10 Fig, 1 Tab, 20 Ref, 1 Append.

Descriptors: *Suspended sediments, *Sediment transport, *Mathematical studies, Turbidity currents, Wind-driven currents, Efficiency concept, Energy dissipation.

One of the most useful methods used to establish sediment transport equations is based on the hypothesis that the rate of sediment transport is related to the energy dissipation of the flow. The energy exchange in streams carrying suspended material was analyzed using an efficiency concept. The efficiency is defined as the ratio between the gain in potential energy of the suspended material and the turbulent dissipation. The efficiency is not constant, but depends linearly on Shields' parameter. The linear relation was used to develop a simple formula, which describes the suspended load as a function of well-known parameters. With the results from open streams an auto-suspension criterion was developed for turbidity currents. This criterion describes the situation when a submerged current carrying suspended material neither deposits nor erodes material. A calculated value of the grain size corresponds well with observed values from the turbidity current in Lake Mead. As no constant efficiency is present in open streams as shown in this study, it seems unlikely that this should be the case in more complicated flows such as for wind-driven currents. Because the linear relation between the efficiency and the Shields' parameter cannot easily be extended to wind-driven suspension in lakes, these kinds of phenomena need more sophisticated methods if a satisfactory description of the suspension processes is to be developed. (Collier-IVI)
W86-00013

**SEDIMENT TRANSPORT BY IRRIGATION RETURN FLOWS IN FOUR SMALL DRAINS WITHIN THE DID-18 DRAINAGE OF THE SULPHUR CREEK BASIN, YAKIMA COUNTY, WASHINGTON, APRIL 1979 TO OCTOBER 1981,**
Geological Survey, Tacoma, WA. Water Resources Div.
P. R. Boucher.
Available from the OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigation Report 83-4167, 1984. 149 p, 8 Fig, 14 Tab, 19 Ref.

Descriptors: *Sediment transport, Sediment yield, Sediment discharge, Suspended sediments, *Irrigation practices, Irrigation-return flow, *Water temperature, Sulphur Creek, Yakima County, *Washington, Best Management Practices, Imhoff Cone readings, Suspended sediment concentrations.

Suspended sediment, water discharges, and water temperatures were monitored in four small drains in the DID-18 basin of the Sulphur Creek basin, a tributary to the Yakima River, Washington. Water outflow, inflow, and miscellaneous sites were also monitored. The information was used to evaluate the effectiveness of management practices in reducing sediment loads in irrigated areas. This study was one of seven Model Implementation Plan projects selected by the U.S. Soil Conservation Service and the U.S. Environmental Protection Agency to demonstrate the effectiveness of institutional and administrative implementation of management plans. Sediment discharges from the four basins could not be correlated with changes in management practices, because Imhoff Cone readings collected for the study showed no statistical differences between the three irrigation seasons. However, one drain acted as a sink for sediment where more lands were sprinkler irrigated; this drain had a smaller proportion of row crops than did the other three drains. (USGS)
W86-00112

**EVALUATION OF A HYDROGRAPH SHIFTING METHOD FOR ESTIMATING SUSPENDED-SEDIMENT LOADS IN ILLINOIS STREAMS,**
Geological Survey, Urbana, IL. Water Resources Div.
R. Frost, Jr., and J. Mansue.
Available from the OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigation Report 84-4037, 1984. 37 p, 14 Fig, 5 Tab, 5 Ref.

Descriptors: *Suspended sediments, *Suspended load, *Hydrographs, *Transport equations, *Illinois, Sediment transport.

A hydrograph-shifting method for estimating monthly and annual suspended-sediment loads was applied to suspended-sediment records for 12 streams in Illinois. Transport equations for each station were developed and synthetic sediment-discharge hydrographs were then generated by using these transport equations and records of daily streamflow. Hydrographs were shifted to measured values of daily sediment discharge selected to represent weekly, biweekly, and monthly sampling frequencies. Estimates of monthly suspended-sediment load ranged from 16 to 326 percent of measured values. Estimates of annual sus-

pended-sediment loads ranged from 41 to 136 percent of measured values. (The method provides a reasonable means of estimating annual loads for most sites.) An experiment designed to measure the subjectivity of the method showed it to be more dependent on the particular days selected as control points than on the person applying the method. An evaluation of the effect of the length of record used to develop transport equations was not conclusive. Although standard errors of estimate showed no improvement, the comparison of estimated loads with measured loads showed slight improvement when 1 or 2 years of data were added to the data used to develop transport equations. (USGS)
W86-00115

**PRELIMINARY APPRAISAL OF SEDIMENT SOURCES AND TRANSPORT IN KINGS BAY AND VICINITY, GEORGIA AND FLORIDA,**
Geological Survey, Doraville, GA. Water Resources Div.
J. B. McConnell, D. B. Radtke, T. W. Hale, and G. R. Buell.
USGS Water-Resources Investigation Report 83-4060, 1983. 68 p, 23 Fig, 15 Tab, 32 Ref.

Descriptors: *Suspended sediment, *Sediment transport, *Estuaries, Velocity, Salinity, Temperature, *Georgia, Camden County, Florida, Nassau County.

Water-quality, bottom-material, suspended-sediment, and current-velocity data were collected during November 1981 in Kings Bay and vicinity to provide information on the sources and transport of estuarine sediments. Kings Bay and Cumberland Sound, the site of the Poseidon Submarine Base in southeast Georgia, are experiencing high rates of sediment deposition and accumulation, which are causing serious navigational and operational problems. Velocity, bathymetry, turbidity, and bottom-material data suggest that the area in the vicinity of lower Kings Bay is accumulating deposits of suspended sediment transported from Cumberland Sound on the floodtide and from upper Kings Bay and the tidal marsh drained by Marianna Creek on the ebbtide. Suspended-sediment discharges computed for consecutive 13-hour ebbtides and floodtides showed that a net quantity of suspended sediment was transported seaward from upper Kings Bay and Marianna Creek. A net landward transport of suspended sediment computed at the St. Marys Entrance indicated areas seaward of St. Marys Entrance may be supplying sediment to the shoaling areas of the estuary, including lower Kings Bay. (USGS)
W86-00125

**RUNOFF, SEDIMENT TRANSPORT, AND WATER QUALITY IN A NORTHERN ILLINOIS AGRICULTURAL WATERSHED BEFORE URBAN DEVELOPMENT, 1979-81,**
Geological Survey, Urbana, IL. Water Resources Div.
H. E. Allen, Jr., and J. R. Gray.
Available from the OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigation Report 82-4073, 1984. 55 p, 15 Fig, 11 Tab, 23 Ref.

Descriptors: *Sediment discharge, *Storm runoff, *Rainfall, *Agricultural runoff, Water pollution sources, Sediment transport, *Sediment yield, *Peak discharge (water), Streamflow, *Agricultural watershed, Erosion, Land use, Water quality, Soil surveys, Particle size, Bedload, Water temperature, Specific conductivity, Dissolved solids, Chemical analysis, Gaging stations, *Illinois, *Upper Spring Creek watershed, Rockford (IL), Storm characteristics, Urban construction, Erosion potential, Land cover.

A study designed to quantify and evaluate changes in runoff and sediment transport attributable to construction activities during urban development of a watershed required identification of pre-construction hydrologic conditions. Data collected before construction on a 2.81 sq m (7.28 sq km) agricultural watershed (upper Spring Creek) near Rockford, IL, show that during a 2-year period ending June 30, 1981, 2,890 tons (2,620 Mg) of suspended sediment were transported from the watershed. Of the 2,890 tons (2,620 Mg), 2,690 tons (2,440 Mg) or 93.1 % were transported during a storm in a 46.6-hour period of June 13-14, 1981. Runoff from a 0.031 sq m (0.080 sq km) subbasin (Spring Creek tributary) transported 33.9 tons (30.9 Mg) of suspended sediment during a 3.2-hour storm period on June 13, 1981. Regression models relating storm suspended-sediment yields and peak-water discharge per square mile for upper Spring Creek and Spring Creek tributary have average standard errors of 57 and 24 %, respectively. Trace amounts of currently banned pesticides, including Aldrin and DDT, were detected in streambed material samples. Documented sediment yields, chemical quality, and relations between runoff and sediment discharge provide baseline information for future evaluation of hydrologic conditions in the watershed. (USGS)
W86-00133

**SOURCES, COMPOSITION, AND TRANSPORT OF SUSPENDED PARTICULATE MATTER IN LOWER COOK INLET AND NORTHWESTERN SHELIKOF STRAIT, ALASKA,**
National Oceanic and Atmospheric Administration, Seattle, WA. Pacific Marine Environmental Lab.
R. A. Feely, and G. J. Massoth.
NOAA Technical Report ERL 415-PMEL 34, January 1982. 28 p, 17 Fig, 2 Tab, 28 Ref.

Descriptors: *Particulate matter, *Chemical analysis, *Seasonal distribution, *Sediment transport, Suspended load, Salinity, Bays, Estuaries, Cook Inlet, Shelikof Strait, *Alaska, Tides, Currents.

The chemical composition and seasonal distribution of suspended particulate matter collected during 1977 and 1978 in lower Cook Inlet and northwestern Shelikof Strait are compared with published data on current patterns. With respect to suspended-matter dispersal patterns, Cook Inlet shows characteristics of both an estuary and an embayment. Estuarine characteristics are exemplified by the association of the inorganic terrestrial material from upper Cook Inlet with the outward-flowing estuarine water. Plots of total suspended-matter concentrations versus salinity for surface and near-bottom waters are roughly linear for the central region of lower Cook Inlet, indicating that dilution of the estuarine water by relatively non-turbid oceanic water is the major factor controlling suspended-matter concentrations in the inlet. Embayment characteristics are indicated by the cross-channel suspended-matter gradients and by the elemental ratios of the particulate matter, which show evidence for movement of Copper River-derived aluminosilicate material across the mouth of the inlet and into Shelikof Strait. These features, which are unique to lower Cook Inlet, are a direct result of the unusual nature of the current patterns existing within the inlet. (Author)
W86-00150

**SUSPENDED PARTICULATE MATTER IN ELLIOTT BAY,**
National Oceanic and Atmospheric Administration, Seattle, WA. Pacific Marine Environmental Lab.
E. T. Baker.
NOAA Technical Report ERL 417-PMEL 35, March 1982. 44 p, 34 Fig, 7 Tab, 17 Ref.

Descriptors: *Particulate matter, Suspended load, *Suspended solids, *Suspended sediment, Distribution, Sediment transport, Elliott Bay, Puget Sound, Bays, *Washington.

The distribution and transport of suspended particulate matter (SPM) in Elliott Bay, an embayment of Puget Sound, Washington, was compared for dry (August) and wet (February) seasons of 1979-1980. During both survey times, the SPM distribution throughout the bay consisted of 1) a thin ($<$ 5 m) surface layer of variable SPM concentration dominated by phytoplankton growth in summer and Duwamish River runoff in winter, 2) a uniform mid-depth minimum-SPM zone, and 3) a bottom nepheloid layer of concentrations and thickness highly variable in space and time. The total mass of SPM in Elliott Bay was about 20% higher in February (15.7 to the 8th g) than in August (13.0 to the 8th g). Scatter plots of salinity vs. SPM for both seasons indicate a strong negative correlation ($r=-.95$) in the surface water and a weaker positive correlation ($r=.52$) in the bottom waters. Vertical and horizontal transport of SPM was measured with sediment traps and current meter/transmissometer deployed at two stations. Accumulation of settled SPM 5 m above the bottom was 16%-30% higher in summer (approximately 34.5 g/sq m/day) than in winter (26.8 g/sq m/day). Organic matter made up 6.9%-12.3% of the trapped sediment. Cross-spectral analysis between near-bottom velocity and SPM concentration showed significant coherency at tidal frequencies. Transport of the SPM was dominated by the mean flow, and diffusion components had little influence. The high positive correlations between SPM and salinity concentrations and low negative correlations between SPM concentrations and current speed imply that advection plays a larger role than resuspension in maintaining the bottom nepheloid layer in Elliott Bay. (Author)
W86-00151

**SEDMNT: A SEDIMENT TRANSPORT SUBMODEL BASED ON HYDRODYNAMIC PRINCIPLES FOR THE UNIFIED TRANSPORT MODEL,**
Oak Ridge National Lab., TN. Environmental Sciences Div.
D. M. Hetrick, M. R. Patterson, and A. L. Sjoreen.
Available from the National Technical Information Service, Springfield, VA 22161 as DE82008904. ORNL/TM-7831, March 1982. 121 p. 5 Fig, 2 Tab, 11 Ref, 4 Append. Contract/Grant No. W-7405-eng-26.

Descriptors: *Computer programs, *Sedimentation, *Computer models, *Mathematical models, *Sediment transport, Streams, Channel flow, Erosion, Scour.

SEDMNT is a computer code written to model the movement of sediment through a stream channel, and is based on the SEDONE model. The mathematical model of SEDMNT consists of a system of coupled, ordinary differential equations for sediment concentration (by size class) which are solved by the Runge-Kutta-Gill integration scheme. Sediment of selected size classes is resident in the channel bed and enters the channel with stream flow. Transportation, erosion, or deposition of sediment may occur for each size class depending on the amount of sediment present and the stream volume, velocity, and turbulence. Input to the model includes flow data from the calling program (UTM) and initial sediment concentrations provided by the user. Output includes a listing of the input and calculated sediment concentrations for selected time steps. Thorough testing of SEDMNT within the framework of UTM will not be possible until a complete data set is available. SEDONE, the basis of SEDMNT, has been thoroughly tested with data from the Hudson, Mississippi, and Atchafalaya Rivers. This testing was done by running SEDMNT with a stand-alone driving program rather than within UTM. It is possible that additional adjustment of the empirical parameters in SEDMNT will be needed as better test data becomes available. The results obtained from SEDMNT for the Walker Branch Watershed are encouraging. Past success with the SEDONE model implies that SEDMNT can be used to produce useful information on the possible fate of transported sediment.
W86-00155

**BUHNE POINT, HUMBOLDT BAY, CALIFORNIA, DESIGN FOR THE PREVENTION OF SHORELINE EROSION: HYDRAULIC AND NUMERICAL MODEL INVESTIGATIONS,**
Coastal Engineering Research Center, Vicksburg, MS.
For primary bibliographic entry see Field 4D.
W86-00169

SHORE STABILIZATION WITH SALT MARSH VEGETATION,
Coastal Engineering Research Center, Fort Belvoir, VA.
For primary bibliographic entry see Field 8G.
W86-00189

HYDROCARBONS ASSOCIATED WITH SUSPENDED MATTER IN THE GREEN RIVER, WASHINGTON,
National Oceanic and Atmospheric Administration, Seattle, WA. Pacific Marine Environmental Lab.
For primary bibliographic entry see Field 5B.
W86-00196

SAND RESOURCES AND GEOLOGICAL CHARACTER OF LONG ISLAND SOUND,
Coastal Engineering Research Center, Fort Belvoir, VA.
For primary bibliographic entry see Field 8E.
W86-00205

STREAM CHANNEL STABILITY ASSESSMENT,
Geological Survey, Menlo Park, CA.
J. C. Brice.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-118190. Report No. FHWA/RD-82-021, January 1982. Final Report. Federal Highway Administration, Washington, DC. 42 p, 33 Fig, 2 Tab, 44 Ref. Coontract/Grant No. DTFH61-81-P-30085.

Descriptors: *Erosion, *Streams, *Hydraulic structures, *Bridges, *Channel morphology, Streambanks, Channel scour, Scour, Channel erosion, Alluvial channels, Highways, Roads, Unstable channels, Bank, erosion, Stream erosion, Stream banks, Maps, Aerial photography, Photography, Meanders, Braided streams, Degradation, Thalweg.

A simple method for determining relative stability of streams is based on stream morphology. This is useful for planning highway bridges. Channel instability is manifested as lateral bank erosion, progressive streambed degradation, or natural scour and fill of the streambed. Four major stream types are distinguished, based on variability of width and presence of bars: equiwidth, point bar; wide-bend, point bar; braided, point-bar; and braided, no point bars. Measurements of bank erosion on a group of 36 streams show that equiwidth streams have the lowest lateral erosion rates; braided, point bar streams have the highest. Erosion rates increase with stream size. Lateral stability may be measured by field assessment, repetitive surveys of channel cross section, and measurement on air photos and maps. Methods for assessing channel degradation include field studies, changes in elevation of the water surface or channel bottom and hydraulic analysis. The degree of meandering and degree of channel instability are unrelated. Natural scour and fill occurs by three different mechanisms, all relevant to bridge pier depth: bed form migration, convergence of flow, and shift of thalweg or braids within a channel.
W86-00214

DEVELOPMENT OF A NUMERICAL MODELING CAPABILITY FOR THE COMPUTATION OF UNSTEADY FLOW ON THE OHIO RIVER AND ITS MAJOR TRIBUTARIES,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
For primary bibliographic entry see Field 2E.
W86-00220

EFFECTS OF BEACH NOURISHMENT ON THE NEARSHORE ENVIRONMENT IN LAKE HURON AT LEXINGTON HARBOR (MICHIGAN),
Coastal Engineering Research Center, Fort Belvoir, VA.
For primary bibliographic entry see Field 6G.
W86-00224

DESIGN FOR PREVENTION OF BEACH EROSION AT PRESQUE ISLE BEACHES, ERIE, PENNSYLVANIA: HYDRAULIC MODEL INVESTIGATION,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
For primary bibliographic entry see Field 8B.
W86-00257

MATHEMATICAL MODEL, SERATRA, FOR SEDIMENT-CONTAMINANT TRANSPORT IN RIVERS AND ITS APPLICATION TO PESTICIDE TRANSPORT IN FOUR MILE AND WOLF CREEKS IN IOWA,
Battelle Pacific Northwest Labs., Richland, WA.
For primary bibliographic entry see Field 5B.
W86-00259

ANSWERS (AREAL NONPOINT SOURCE WATERSHED ENVIRONMENT RESPONSE SIMULATION) USER'S MANUAL,
Purdue Univ., Lafayette, IN. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 4D.
W86-00287

## 2K. Chemical Processes

AVERAGE RAINWATER PH, CONCEPTS OF ATMOSPHERIC ACIDITY, AND BUFFERING IN OPEN SYSTEMS,
Texas Univ. at Austin. Dept. of Environmental Health Engineering.
For primary bibliographic entry see Field 5B.
W86-00001

ANALYSIS AND INTERPRETATION OF DATA OBTAINED IN TESTS OF THE GEOTHERMAL AQUIFER AT KLAMATH FALLS, OREGON,
Geological Survey, Menlo Park, CA. Water Resources Div.
For primary bibliographic entry see Field 2F.
W86-00107

HYDROGEOLOGIC AND WATER-QUALITY CHARACTERISTICS OF THE MOUNT SIMON-HINCKLEY AQUIFER, SOUTHEAST MINNESOTA,
Geological Survey, St. Paul, MN. Water Resources Div.
R. J. Wolf, J. R. Ruhl, and D. G. Adolphson.
USGS Water-Resources Investigation Report 83-4031, 1983. 2 p, 14 Fig, 3 Tab, 19 Ref.

Descriptors: *Groundwater, *Water quality, *Aquifers, *Maps, Minnesota, Hollandale embayment, Twin Cities basin.

The Mount Simon-Hinckley aquifer comprises a thick sequence of sandstone, siltstone, and shale that underlies southeast Minnesota. It is an important aquifer in the Hollandale embayment and in the populous Twin Cities metropolitan area, where it supplies about 10 percent of the groundwater used. Withdrawals increase significantly north of the Twin Cities basin, but some additional development of water supplies is still possible. Yields to wells are generally about 500 gallons per minute but may be as much as 2,000 gallons per minute locally. Dissolved-solids concentrations are slightly lower than in water from other aquifers in the Hollandale embayment and range from about 100 milligrams per liter in the north to as much as 2,400 milligrams per liter in the south. Dominant water type is calcium magnesium bicarbonate; however, sodium chloride-type water is found at depth. Water from the aquifer locally contains iron and manganese in concentrations greater than 1 milligram per liter. (USGS)
W86-00109

QUALITY OF WATER, QUILLAYUTE RIVER BASIN, WASHINGTON,
Geological Survey, Tacoma, WA. Water Resources Div.
M. O. Fretwell.
Available from the OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigation Report 83-4162, 1984. 96 p, 24 Fig, 16 Tab, 35 Ref.

Descriptors: *Water quality, *Groundwater, *Surface water, *Estuaries, Quileute Indian Reservation, Quillayute River, *Washington.

Groundwater in Quillayute River basin is generally of the calcium bicarbonate type, although water from some wells is affected by seawater intrusion and is predominantly of the sodium chloride type. The water is generally of excellent quality for most uses. River-water quality was generally excellent, as evaluated against Washington State water-use and water-quality criteria. Fecal coliform concentrations in all major tributaries met State water-quality criteria; water temperatures occasionally exceeded criteria maximum during periods of warm weather and low streamflow. Nutrient concentrations were generally low to very low. The four largest lakes in the basin were temperature-stratified in summer and one had an algal bloom. The Quillayute estuary had salt-wedge mixing characteristics; pollutants entering the salt wedge tended to spread to the toe of the wedge. Upwelling ocean water was the major cause of the low dissolved-oxygen concentrations observed in the estuary; ammonia concentrations in the estuary, however, were increased by the upwelling ocean waters. As in the rivers, total-coliform bacteria concentrations in the estuary were greater than fecal-coliform concentrations, indicating that many of the bacteria were of nonfecal origin and probably originated from soils. (USGS)
W86-00111

INVESTIGATION OF WAIKELE WELL NO. 2401-01, OAHU, HAWAII: PUMPING TEST, WELL LOGS AND WATER QUALITY,
Geological Survey, Honolulu, HI. Water Resources Div.
P. R. Eyre.
Available from the OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigation Report 83-4089, 1983. 38 p, 9 Fig, 5 Tab, 6 Ref.

Descriptors: *Groundwater quality, *Irrigation return flow, *Ghyben-Herzberg groundwater lens, *Aquifer testing, Oahu, *Hawaii, Basalt aquifer.

Field tests indicate that an abandoned well (No. 2401-01) near the confluence of Waikele and Kipapa Streams, Oahu, Hawaii, can be reactivated to produce potable water at a rate of 400-500 gallons per minute. Previous tests in 1946 and 1954 indicated that the well tapped the brackish transition zone which inderlies the Ghyben-Herzberg lens of the Pearl Harbor aquifer. Results of this study, based on geologic and geophysical logs of the wall, as well as on pumping test and water-quality data, indicate that the slightly brackish water produced by the well results from brackish irrigation return water. It does not appear that pumping from this well will cause seawater upconing or intrusion. (USGS)
W86-00118

EFFECTS OF ACID RAIN ON SOIL AND WATER,
Connecticut Agricultural Experiment Station, New Haven.
E. C. Krug, and C. R. Frink.
Bulletin 811, November 1983. 45 p, 6 Fig, 7 Tab, 299 Ref.

Descriptors: *Acid rain, *Acidic water, *Acidic soils, *Chemical properties, *Land use, Organic acids, Air pollution, Forest watersheds, Forest soils, Water pollution, Leaching, Aluminum, Reforestation, Water pollution sources.

The impact of acid rain on soil and water can only be judged by placing it in perspective with the natural processes of soil acidification. Most of the natural acidity of rain is due to H2CO3, a weak acid that does not completely dissociate. The acidi-

ty of rain can also be expressed in terms of its ability to neutralize basic substances such as limestone. Man-made inputs are very small when compared with normal agricultural amendments with limestone, or with the tremendous amounts of acidity produced in forest soils on highly siliceous parent material. Acidity in soils is generated by biological decomposition which creates oxides of C, N, and S that react with water to form acids. Because cation exchange reactions are rapid, extra H ions from acid rain could leach nutrient cations from the soil. Despite chemical and biological evidence that acid rain will not enhance leaching of nutrient cations from the acid forest soils of the Northeast, southeastern Canada and Scandinavia, misconceptions about the nature of soil acidity sustain the notion that acid rain is increasing acidification of soil and water. Another misconception is that the rate of acid production in soil is equal to the rate of mineral weathering plus acid export. The largest cause of acidification of lakes and streams is generally the revegetation and reforestation of disturbed land. The degree to which acid rain may be accelerating this process needs to be evaluated on a watershed basis.
W86-00166

**DISSOLVED METHANE CONCENTRATIONS IN THE SOUTHEAST BERING SEA, 1980 AND 1981,**
Science and Education Administration, Fort Lauderdale, FL. Aquatic Plant Management Lab.
C. N. Katz, J. D. Cline, and K. Kelly-Hansen.
NOAA Data Report ERL PMEL-6, July 1982. 194 p, 4 Ref, 3 Append.

Descriptors: *Methane, *Water Quality, Water chemistry, *Data collections, *Chemical analysis, Salinity, Solubility, *Bering Sea.

Dissolved methane was measured in the southeastern Bering Sea as a part of the Outer Continental Shelf Environment Assessment Program, administered by the National Oceanic and Atmospheric Administration. Methane analysis was routinely done in the field using a purge and trap technique, followed by quantitation on a Hewlett-Packard 5710 A gas chromatograph. The data presented are organized in a hierarchy of cruise (chronological order), station and depth distribution. Station data include: station number, latitude and longitude to the nearest tenth of a degree; local data and time of sampling, Greenwich Mean Time zone, and depth to the bottom in meters. Depth information includes: depth of the sample in meters, water temperature in degrees centigrade, salinity in grams per kilogram, sigma-t, dissolved methane concentration in nanoliters of methane gas per liter seawater corrected to standard temperature and pressure (STP), dissolved methane equilibrium solubility, and the methane solubility ratio (C/C*), which is the ratio of the observed methane concentration to the equilibrium solubility methane concentration.
W86-00180

**KARNES COUNTY, TEXAS, AREA HYDROCHEMICAL AND STREAM URANIUM ORIENTATION STUDY,**
Du Pont de Nemours (E.I.) and Co., Aiken, SC. Savannah River Lab.
K. F. Steele.
National Uranium Resource Evaluation Program, Report No. DPST-81-141-18, April 1982. 14 p, 1 Fig, 6 Tab, 5 Ref. Contract/Grant No. DE-AC09-76SR00001.

Descriptors: *Geochemistry, *Uranium, *Groundwater, *Water analysis, Wells, Mineral industry, Water pollution sources, Fate of pollutants, Karnes County, Texas, Surface water, Sediments, Bed sediments, Suspended sediments.

Groundwater sampling may be an effective method of sampling for uranium deposits in South Texas. Stream and groundwater samples were collected over and near known uranium deposits. The stream water quality parameters were more constant than the groundwater parameters. For example, pH was 7.5-8.5 in surface water, 6.2-9.1 in groundwater; conductivity was 1100-2300 micromhos/cm in surface water, 54-8900 micromhos/cm in groundwater; uranium, $< 4$ to 25 parts per billion in surface water, about 2 parts per million in stream sediment, and $< 4$ to 66 parts per billion in groundwater. Samples with high uranium levels were collected in wells penetrating known ore zones. Sulfate levels were also high in high-uranium samples.
W86-00194

## 2L. Estuaries

**TRACER APPLICATIONS OF ULTRA-VIOLET ABSORPTION MEASUREMENTS IN COASTAL WATERS,**
University Coll. of North Wales, Menai Bridge. Marine Science Labs.
P. Foster.
Water Research, Vol. 19, No. 6, p 701-706, 1985. 3 Fig, 2 Tab, 15 Ref.

Descriptors: *Environmental tracers, *Ultraviolet absorption, *Coastal waters, *Absorption, Radiation, Tracers, Organic compounds, Inorganic compounds, Nitrates, Bromides.

The ultra-violet absorption properties of natural waters may be used as a tracer for following the distribution of source waters in coastal water systems. Measurements can be made readily upon sample collection and filtration on board ship. The form of the spectrum can be considered as two distinct sections: within the spectral region 250-350 nm modifications of the UV absorption are direct manifestations of changes in the concentration and/or nature of the dissolved organic matter; below 250 nm inorganic species, such as nitrate and bromide, in addition to the dissolved organic matter, contribute to the absorption. UV data was collected during two winter cruises off the west coast of Great Britain. Four absorption indices were developed as being of potential tracer value to mixing studies in coastal waters. The intensity factor in the organic region of the spectrum was numerically evaluated as the integrated absorption (Sigma A) between 250 and 350 nm, while the magnitude of the absorption at 225 nm (A225) was adopted as the intensity factor for the composite region. The organic and composite shape factors were evaluated as the absorption ratios, A250/A275 and A225/A250, respectively. In March salinity was highly correlated with Sigma A. Offshore waters were characterized by high salinities and low values of Sigma A. Coastal waters of low salinity and high Sigma A formed the other end member and in contrast to the analogous mixing diagram for December there was no clear distinction between bay and coastal waters with respect to their Sigma A loading. The relationship which best met the tracer criterion of a low correlation coefficient was that between salinity and the intensity factor A225; this relationship provided a very effective separation of three water types. A marked temporal change in the absorption characteristics was associated the waters in particular areas. As a consequence, the most effective combination of tracer indices at one time of year may not necessarily be the most effective combination at another. (Collier-IVI)
W86-00056

**EFFECTS OF SPATIAL VARIATION IN AMPLITUDE AND PHASE OF THE OSCILLATORY TIDAL CURRENTS ON THE RESIDUAL LAGRANGIAN DRIFTS,**
Delaware Univ., Newark. Coll. of Marine Studies.
K.-C. Wong.
Water Resources Research, Vol. 21, No. 5, p 769-774, May, 1985. 6 Fig, 5 Ref.

Descriptors: *Tidal currents, *Estuarine environment, *Lagrangian circulation, Circulation, Water currents, Tidal waters, Spatial distribution, Velocity.

The understanding of the characteristics of residual Lagrangian circulation in estuaries is important, since the transport of dissolved or suspended material is a Lagrangian phenomenon. The basic behaviors of residual Lagrangian drifts under the influence of oscillatory tidal currents with spatial variations in amplitude and phase are examined analytically for relatively simple Eulerian velocity fields. Intense residual Lagrangian drifts are generated by strong spatial velocity gradients and the residual drifts at any given location are heavily dependent on the initial release time relative to the phase of the tidal current. A relatively weak mean flow can interact with the tidal currents and produce significant modification of the residual drifts as well as their dependency on the initial conditions. Both the magnitude and the direction of the mean flow are important in affecting the dependency of the residual drift estimates on the initial conditions. The presence of strong spatial variation in tidal current may render the approximation of some equations invalid so estimation of residual Lagrangian drifts based on limited Eulerian measurements will lead to large errors under these circumstances. Strong spatial gradients in tidal currents are able to induce intense residual Lagrangian drifts and these residual drifts depend strongly on the release time relative to the phase for the tidal currents. Given a tidal current field with strong spatial gradients, a relatively weak mean flow can modify the residual drifts as well as their dependency on the initial conditions significantly. The mean flow direction is very important to the residual drift estimates. (Baker-IVI)
W86-00085

**CIRCULATION IN THE LOWER COOK INLET, ALASKA,**
National Oceanic and Atmospheric Administration, Seattle, WA. Pacific Marine Environmental Lab.
R. D. Muench, J. D. Schumacher, and C. A. Pearson.
NOAA Technical Memorandum ERL PMEL-28, July 1981. 26 p, 10 Fig, 2 Tab, 32 Ref.

Descriptors: *Water currents, *Tidal currents, *Flow rates, Ocean currents, Flow pattern, Flow, Cook Inlet, Shelikof Strait.

Circulation in the lower Cook Inlet region has been described and discussed utilizing current observations obtained during October 1977-October 1978. The major circulation feature was a mean westerly flow which entered the region via Kennedy and Stevenson entrances, parallels the 100-m isobath through the lower Inlet, then exits the system via Shelikof Strait. Summer mean current speeds in this flow were 10-15 cm/s. Winter speeds were 25-30 cm/s. A secondary circulation feature was present as a southward flow which occupied the western portion of the lower Inlet. Summer current speeds here were 15-20 cm/s, while winter speeds were of order 10 cm/s. The westerly flow is driven in summer primarily by a baroclinic field consequent to coastal freshwater input (the Kenai Current), while in winter this flow is driven to a greater extent by wind-driven coastal convergence and possibly by an alongshore pressure gradient set up by the Alaskan Stream. The southward flow, driven by freshwater input into upper Cook Inlet, therefore is larger in summer when this input is greater. Mean flow in the eastern lower Inlet was weak and variable in all seasons. Low-frequency and tidal flow fluctuations were superimposed upon the mean flow, and in regions of low mean speeds, controlled the instantaneous flow. The low-frequency fluctuations were associated with westerly flow through the system. Tidal currents were large (70-100 cm/s) and primarily semidiurnal in the eastern portion of the the lower Inlet and in the Kennedy and Stevenson entrances. In the western Inlet, tidal currents were only half this magnitude, and in Shelikof Strait they were very small due to the presence of an antinode near the mooring in northern Shelikof Strait. Tidal currents were aligned with the local channel bathymetry. (Author)
W86-00149

**SOURCES, COMPOSITION, AND TRANSPORT OF SUSPENDED PARTICULATE MATTER IN LOWER COOK INLET AND NORTHWESTERN SHELIKOF STRAIT, ALASKA,**

National Oceanic and Atmospheric Administration, Seattle, WA. Pacific Marine Environmental Lab.
For primary bibliographic entry see Field 2J.
W86-00150

SUSPENDED PARTICULATE MATTER IN ELLIOTT BAY,
National Oceanic and Atmospheric Administration, Seattle, WA. Pacific Marine Environmental Lab.
For primary bibliographic entry see Field 2J.
W86-00151

ATCHAFALAYA RIVER DELTA; REPORT 9: WIND CLIMATOLOGY,
Coastal Engineering Research Center, Vicksburg, MS.
B. A. Ebersole.
Technical Report HL-82-15, January 1985. Report 9 of a Series. 122 p, 57 Fig, 44 Tab, 6 Ref.

Descriptors: *Climatology, *Hydrodynamics, *Wind, *Weather patterns, *Bays, Wind velocity, Meteorological data collection, Seasonal variation, Model studies, Statistical analysis, Weather data collections.

Data on the wind climate typical of the Atchafalaya Bay area were gathered from October 1981 to October 1982. These data along with data from National Weather Service stations were statistically analyzed to give estimates of wind speed and direction. These statistics were then related to the different kinds of weather patterns that affect this region by categorizing these patterns into seven all-inclusive types with each defined by a particular set of dynamical characteristics. Data was provided on the frequency of occurrence of wind conditions both with and without regard to their causative factors. The latter results were used to substantiate results obtained using the statistical-climatological approach. The long-term historical data gave information on extreme wind conditions that can be expected to occur in any given year. This data can be used to better understand physical processes within the bay that are strongly dependent on local wind conditions such as hydrodynamic circulation patterns, flooding and drying of marshes, dispersion and disposition of sediments, dispersion of any pollutants, and distribution of fresh and salt water.
W86-00163

CURRENT MEASUREMENTS IN THE COLUMBIA RIVER ESTUARY,
Chalmers Univ. of Technology, Goeteborg (Sweden). Institutionen foer Kaernkemi.
M. R. Mulhern.
Master of Science, Report. University of Washington, Seattle. 1982. 60 p, 10 Fig, 2 Tab, 16 Ref, 1 Append.

Descriptors: *Water currents, *Computer programs, Tidal currents, Estuaries, Current meters, Columbia River.

The principal product of this study was the development and analysis of contour plots of mean phase difference and velocity ratios, at the Columbia River entrance. Surface and subsurface currents were monitored by drifter buoys and subsurface current meters respectively in September 1981. Analog plots of the field data were scanned visually, and smoothed to eliminate high-frequency noise. A computer data base was produced containing flow information sorted by current meter depth, and type of event (slack, flood or ebb). A series of computer programs were written to process the data and generate composite views of mean phase difference and velocity ratios, as compared to predicted tidal currents.
W86-00181

NORFOLK HARBOR AND CHANNELS DEEPENING STUDY, REPORT 1: PHYSICAL MODEL RESULTS, CHESAPEAKE BAY HYDRAULIC MODEL INVESTIGATION,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
D. R. Richards, and M. R. Morton.
Technical Report HL-83-13, June 1983. Final Report. 371 p, 29 Fig, 14 Tab, 236 Plates, 9 Ref.

Descriptors: *Estuaries, *Saline water intrusion, *Channel improvement, *Water currents, *Tidal effects, Shallow water, Salinity currents, Navigation, Model studies, Hydraulic models, Norfolk Harbor, Chesapeake Bay, Tidal currents, Neap tides, Spring tides, Stratification, Harbors.

A physical model was use to study the impact of deepening the approach channels to Norfolk and Newport News, Virginia, in the Chesapeake Bay. Steady-state tests were designed to determine the tide and current velocity effects. The dynamic tests were used to study salinity redistribution. The salinity study showed the following: neap-spring variations (as great as 5-8 ppt) in salinity stratification, an increase in salinity intrusion normally confined to deep water areas (shallow water only slightly affected), redistribution of salt within the cross section of channels with adjacent shallow water (salinity increase in channel and decrease in shallow water), and net increase in depth-averaged salt with an increase in stratification. On the average, changes in salinity were less than 2 ppt.
W86-00266

# 3. WATER SUPPLY AUGMENTATION AND CONSERVATION

## 3A. Saline Water Conversion

HIGH-TEMPERATURE DESALINATION CAPABILITY OF TFC 1501 REVERSE OSMOSIS ELEMENT,
Army Mobility Equipment Research and Development Command, Fort Belvoir, VA.
H. H. Goto.
Available from the National Technical Information Service, Springfield, VA 22161 as AD1A121059. Report 2367, July 1982. 36 p, 7 Fig, 4 Tab, Append.

Descriptors: *Desalination apparatus, *Reverse osmosis, Membrane processes, Water treatment, Saline water.

The desalination capability of spiral-wound thin-film composite reverse osmosis elements (TFC 1501) was determined at temperatures up to 132 F, higher than the 113 F specified by the manufacturer. The elements were not degraded in desalinizing capability following exposure for 400 hours to feedwater at about 130 F. The production rate of the elements dropped less than 5% under the following conditions: 400 hours at 130 F and 200 hours at 130 F and high pressure (600 lb per sq in). The drop in production rate can be compensated for by operation at higher pressure, 1000 lb per sq in. Some telescoping of the elements occurred during high-temperature operation, but performance characteristics were not degraded.
W86-00265

## 3B. Water Yield Improvement

RAINWATER CATCHMENT WATER QUALITY IN MICRONESIA,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Agricultural Engineering.
T. A. Dillaha, III, and W. J. Zolan.
Water Research, Vol. 19, No. 6, p 741-746, 1985. 1 Fig, 3 Tab, 18 Ref.

Descriptors: *Rainwater catchment systems, *Domestic water, *Micronesia, *Water quality, Bacteria, Cisterns, Potable water, Water supply, Coliforms.

Rainwater catchment systems (RWCS) in Micronesia were sampled to assess their bacteriological water quality and to determine which RWCS characteristics had a significant impact on water quality. Total and fecal coliform bacteria tests were used to evaluate 203 catchments on 10 islands. Fifty-seven percent of the RWCS had no fecal coliform bacteria and 61% had fewer than 10 total coliform bacteria per 100 ml. Catchment characteristics were found to have a statistically significant effect on total coliform bacteria levels but they did not affect fecal coliform bacteria concentrations. Rainwater catchment systems were found to provide acceptable water in most cases but disinfection prior to consumption is still highly recommended. (Author's abstract)
W86-00061

CLOUD PHYSICS STUDIES IN THE SCPP: INTERIM PROGRESS REPORT, 1983-84,
Wyoming Univ., Laramie. Dept. of Atmospheric Science.
December 29, 1984. 123 p. Contract/Grant No. 2-07-81-V0256.

Descriptors: *Precipitation, *Weather modification, *Cloud seeding, Cloud physics, Orographic precipitation, Sierra Cooperative Pilot Project, Ice.

Several articles report some of the scientific contributions to the Sierra Cooperative Pilot Project. The shallow orographic cloud which remains on the Sierra barrier following passage of upper level hyperbaroclinic zones and katabatic fronts usually contains a substantial amount of supercooled water. The seedability of this cloud will be investigated. In a seeding experiment with dry ice, seeding effects were observed. Combined hydrometeor distributions from three PMS probes were described. In the ice multiplication region centered at -5 degrees C, the combined data are superexponential distributed so that they fit a straight line on a log-log plot. The remaining articles are reprints of referred articles and conference papers.
W86-00305

STRUCTURE OF COLD FRONTS OVER CALIFORNIA,
Wyoming Univ., Laramie. Dept. of Atmospheric Science.
J. D. Marwitz.
In: Cloud Physics Studies in the SCPP: Interim Progress Report, 1983-84, December 29, 1984. p 1-28, 8 Fig, 12 Ref.

Descriptors: *Precipitation, *Weather modification, *Cloud seeding, Cloud physics, Katabatic frontal theory, California, Fronts, Sierra Nevadas.

The structure of cold fronts as they move over the Sierra barrier of California are described. The structure of the katabatic front on February 12, 1983, is presented including the kinematic structure as revealed by the serial rawinsondes at Sheridan, California, and the precipitation process as revealed by King Air cloud physics data. These katabatic fronts may represent significant seeding potential.
W86-00306

RESPONSES TO SEEDING CLOUDS WITH DRY ICE IN THE SCPP-1 EXPERIMENT,
Wyoming Univ., Laramie. Dept. of Atmospheric Science.
A. R. Rodi.
IN: Cloud Physics Studies in the SCPP: Interim Progress Report, 1983-84, December 29, 1984. p 29-52, 14 Fig, 1 Ref.

Descriptors: *Weather modification, *Precipitation, *Cloud seeding, Orographic precipitation, Cloud physics, Sierra Cooperative Pilot Project, Ice, Dry ice.

Three case studies of treatment of convective clouds were presented. The two cases on March 15, 1984, were probably unseeded. This conclusion is based on the overwhelming body of physical evidence in which no seeding signature was found. The proximity of the seeding to natural echoes (even downwind of them) was not intentional in these cases. The lack of growth of the second cloud was probably the result of the presence of

these large natural cells. The two clouds, studied within the three-hour experiment, were very different in properties as indicated by the response variables presented. The first cloud, while having more initial ice present, persisted longer and had a much larger quantity of precipitation at 18 min than the second cloud. Both clouds, however, were clearly not in the formation region upwind of naturally occurring echoes as prescribed in the design document. The intentional seeding of the large convective cell on February 24, 1984, while producing a microphysical seeding signature, demonstrates the problems which are introduced by seeding convective clouds in proximity of other echoes. While this did not show that the cloud was not seedable, at no time did the seeded region reach the reflectivities equivalent to the natural echoes on nearby storms. In the future, more vigilance is required on the part of both the aircraft and radar crews to avoid such anomalies. The results of these three analyses are evidence that the technology for seeding and studying single convective clouds is established. (Author)
W86-00307

## 3D. Conservation In Domestic and Municipal Use

MUNICIPAL WATER DEMANDS,
Johns Hopkins Univ., Baltimore, MD. Dept. of Applied Economics.
For primary bibliographic entry see Field 6D.
W86-00275

## 3E. Conservation In Industry

INDUSTRIAL WATER DEMANDS,
Operational Economics, Inc., Houston, TX.
For primary bibliographic entry see Field 6D.
W86-00273

## 3F. Conservation In Agriculture

SEDIMENT TRANSPORT BY IRRIGATION RETURN FLOWS IN FOUR SMALL DRAINS WITHIN THE DID-18 DRAINAGE OF THE SULPHUR CREEK BASIN, YAKIMA COUNTY, WASHINGTON, APRIL 1979 TO OCTOBER 1981,
Geological Survey, Tacoma, WA. Water Resources Div.
For primary bibliographic entry see Field 2J.
W86-00112

AGRICULTURAL WATER DEMANDS,
For primary bibliographic entry see Field 6D.
W86-00274

# 4. WATER QUANTITY MANAGEMENT AND CONTROL

## 4A. Control Of Water On The Surface

ADVANCEMENT IN HYDRAULIC MODELING OF POROUS PAVEMENT FACILITIES,
Espey, Huston and Associates, Inc., Austin, TX.
For primary bibliographic entry see Field 2E.
W86-00098

PLANNING AND IMPLEMENTATION OF REGIONAL STORMWATER MANAGEMENT FACILITIES IN MONTGOMERY COUNTY, MARYLAND,
Greenhorne and O'Mara, Inc., Riverdale, MD.
J. M. Crouse, V. H. Berg, and L. J. Mitchell.
In: Proceedings of Stormwater and Water Quality Model User Group Meeting, January 27-28, 1983, University of Florida, Gainesville. p 255-271, 3 Fig, 4 Tab.

Descriptors: *Watershed management, *Model studies, *Runoff, *Storm runoff, *Erosion control, *Land development, *Urbanization, *Water quality management, Land use, Urban watersheds, Models, Sedimentation, Stream degradation, Storm water, Urban runoff, Detention reservoirs.

Increased flooding, accelerated channel erosion, and reduced water quality of streams in Montgomery County, Maryland due to urbanization and land development has led to the enactment of legislation requiring sediment control during land development. In 1971 the Montgomery Soil Conservation District (MSCD) adopted a stormwater management (SWM) policy requiring the detention of stormwater runoff from the 2-yr storm event on each development site. In 1973 control was mandated by the County's Department of Environmental Protection on a watershed basis. The remedial focus of the County SWM program includes projects to correct existing problems caused by uncontrolled runoff from previously developed areas as well as preventive programs to study the effects of proposed land use plans and their effects on stormflow throughout the watershed. In 1980 a stormwater management ordinance was enacted which relies heavily on the use of centralized SWM facilities which may serve a number of developments. The Cabin Branch study represents one of several case studies being conducted by the County to assess the effects of SWM on subwatersheds. Computerized hydrologic modeling was used to project peak discharges for various development and land use scenarios. Results of these studies indicate that three SWM facilities should be designed and constructed in the Cabin Branch Watershed at specific sites.
W86-00099

TIME-OF-TRAVEL DATA FOR NEBRASKA STREAMS, 1968 TO 1977,
Geological Survey, Lincoln, NE. Water Resources Div.
For primary bibliographic entry see Field 2E.
W86-00120

IMPROVING TECHNOLOGY FOR CHEMICAL CONTROL OF AQUATIC PLANTS,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
K. K. Steward.
Miscellaneous Paper A-82-4, August 1982. Annual Report for FY 1980. Army Engineer Waterways Experiment Station, Vicksburg, MS. 51 p, 13 Fig, 15 Tab, 8 Ref, Append.

Descriptors: *Aquatic weed control, *Herbicides, *Weed control, 2,4-D, Water hyacinth, Hydrilla, Watermilfoil, Duckweed, Southern naiad, Fenac, Dichlobenil, Pesticides, Cabomba, Water lettuce, Polymers.

Several chemical aquatic weed control techniques were evaluated using a newly developed standard protocol. The release of 2,4-D from the MOE/GMA copolymer (2-methacryloyloxyethyl 2,4-dichlorophenoxyacetate glycerylmethacrylate) in flowing water following an initial application rate of 0.01 to 0.25 mg per liter was linear over 70 days. The compound was effectively phytotoxic to Eurasian watermilfoil for about 4 mo. A dichlobenil-beeswax controlled-released system produced rapid and inconsistent release of the herbicide. Two of three controlled-release fenac formulations were effective against hydrilla at 1.0 mg per liter in 10 wk and against Southern naiad at 1.0 mg per liter in about 8 wk. Cabomba was not controlled. Eurasian watermilfoil was controlled in 16 wk at 0.5 mg per liter. A coded compound (R0-3-7042) was effective against hydrilla over 16 wk at 1.0 mg per liter treatment rate and against Southern naiad in about 8 wk at 5.0 mg per liter. It was very effective against water lettuce at 1.0 mg per liter; marginally effective against water hyacinth; and ineffective against duckweed and cabomba. A growth retardant (EL-507) controlled water hyacinth at 1.0 kg per hectare.
W86-00183

PROCEEDINGS, 16TH ANNUAL MEETING, AQUATIC PLANT CONTROL RESEARCH PLANNING AND OPERATIONS REVIEW.
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
November 17-19, 1981, St. Paul, Minnesota. Miscellaneous Paper A-82-3, June 1982. Final Report. 277 p.

Descriptors: *Weed control, *Aquatic weeds, *Biocontrol, *Herbicides, Aquatic plants, Water hyacinth, Watermilfoil, Hydrilla, Insects, Aquatic insects, Lake Conway, Florida, Fish, White amur, Grass carp, Ecological effects, 2,4-D, Pesticides, Model studies, Fate of pollutants, Wildlife, Parapoynx, Sameodes, Microorganisms, Pathogens, Dredging, HARVEST model, Mechanical control.

Mechanical, chemical, and biological control of aquatic weeds is included in this collection of research papers and weed control activities in regional districts of the Army Engineers. The Limnos mechanical harvesting system improved vertical water mixing and did not significantly decrease dissolved oxygen levels after harvest. The HARVEST mathematical model proved useful in evaluating effects of equipment and environmental conditions on harvesting. Chemical control methods included controlled-release 2,4-D formulations, structural investigation of a naturally occurring hydrilla inhibitor, and the fate of 2,4-D in water, sediment, and fish. Several biological controls proved potentially effective as weed control agents: Parapoynx (an aquatic moth), Sameodes albiguttalis, a variety of insects collected on overseas trips, and microorganisms. A method for surveying aquatic plants on a large scale was demonstrated in the Galveston, Texas, district. Application of endothall to watermilfoil and hydrilla proved most effective in spring. Large-scale operations management of aquatic weeds with white amur was studied in Lake Conway, Florida. The fish population controlled aquatic vegetation without major detrimental effects on native vertebrates or invertebrates. However, desirable vegetation was also eaten. The diver-operated dredge proved efficient for removing small populations of watermilfoil with little fragmentation.
W86-00192

LARGE-SCALE OPERATIONS MANAGEMENT TEST OF USE OF THE WHITE AMUR FOR CONTROL OF PROBLEM PLANTS: SELECTED LIFE HISTORY INFORMATION OF ANIMAL SPECIES ON LAKE CONWAY, FL,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
N. J. Zittleman, R. R. Williams, and E. G. Buglewicz.
Miscellaneous Paper A-82-5, August 1982. Final Report. 101 p, 16 Ref, 3 Append.

Descriptors: *Lakes, *Weed control, *Baseline studies, *Habitats, *Animals, Aquatic animals, Lake Conway, Florida, White amur, Grass carp, Fish, Aquatic weeds, Aquatic habitats, Birds, Fish, Mammals, Amphibians, Reptiles, Food habits, Nesting, Ecology, Biocontrol, Environmental effects, Fish management.

A baseline study of the animal species in Lake Conway, Florida, lists 180 species sighted or collected during January 1976 through September 1977. This is an early activity in the large-scale management test to document the effects of the introduction of the white amur fish for controlling aquatic weeds. Appendix A is a species list with scientific names for 35 fish, 54 birds, 7 mammals, and 28 herpetofauna. Appendix B describes the life history and managment information for each of the species. Appendix C concerns feeding, resting, and reproduction or nesting habitat requirements for the animals. In this list appear several categories with the numbers of the species fitting the category. For example, under food preferences of herpetofauna, 20 types of food are listed with the animal species that use each type.
W86-00197

## Group 4A—Control Of Water On The Surface

LARGE-SCALE OPERATIONS MANAGEMENT TEST OF USE OF THE WHITE AMUR FOR CONTROL OF PROBLEM AQUATIC PLANTS: THE HERPETOFAUNA OF LAKE CONWAY, SPECIES ACCOUNTS,
University of South Florida, Tampa. Dept. of Biology.
For primary bibliographic entry see Field 6G.
W86-00202

2,4-D THRESHOLD CONCENTRATIONS FOR CONTROL OF EURASIAN WATERMILFOIL AND SAGO PONDWEED,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
J. F. Hall, H. E. Westerdahl, R. E. Hoeppel, and L. Williams.
Technical Report A-82-6, December 1982. Final Report. 20 p, 6 Fig, 3 Tab, 12 Ref.

Descriptors: *Weed control, *Aquatic weed control, *Herbicides, Aquatic plants, 2,4-D, Macrophytes, Watermilfoil, Pondweed, Diluter system.

The objective of this study was to use a modified diluter system to determine the minimum sustained (threshold) concentrations of 2,4-dichlorophenoxy acetic acid (2,4-D) required to control the growth of Eurasian watermilfoil (Myriophyllum spicatum L.) and Sago pondweed (Potamogeton pectinatus L.). This study was designed to incorporate recommended improvements and to verify results from a previous pilot study. The diluter system delivered five different concentrations of 2,4-D to five sets of four test aquaria. Another set of four reference aquaria received only tap water. Each aquarium contained meristematic cuttings of M. spicatum and germinated tubers of P. pectinatus planted in beakers containing a standard hydrosoil. Plant injury was assessed after 11 weeks of continuous exposure to the various 2,4-D concentrations. Based on the results of this study, the 2,4-D threshold concentrations required to control M. spicatum and P. pectinatus were determined to be 0.05 to 0.10 mg per liter and 0.10 to 0.25 mg per liter, respectively. This coincided with previous results obtained from a 6-week pilot study. (Author)
W86-00208

MISSION BAY HARBOR, CALIFORNIA, DESIGN FOR WAVE AND SURGE PROTECTION AND FLOOD CONTROL: HYDRAULIC MODEL INVESTIGATION,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
For primary bibliographic entry see Field 8B.
W86-00255

## 4B. Groundwater Management

USES OF RECHARGE WELLS IN WATER SUPPLY,
Keuringsinstituut voor Waterleidingartikelen, Rijswijk (Netherlands).
J. H. Peters.
Journal of the American Water Works Association, Vol. 77, No. 5, p 47-51, 16 Fig, 16 Ref.

Descriptors: *Groundwater recharge, *Artificial recharge, *Water supply development, *Wells, Infiltration, Recharge wells, Groundwater flow, Computer models.

Recharge wells, wells by means of which a liquid can be put into the ground have many applications in the field of water supply. Recharge wells can be used for compensating locally for the drawdown of the water table or groundwater head, for regulating the flow of contaminated or salt groundwater, for limiting the catchment and protection zone of a groundwater pumping station and in the technique known as artificial recharge. With a system of recharge and pumping wells it is possible to reduce fluctuations in water quality. Hydrological aspects of three applications of recharge wells were studied using imaginary models, and computer models used to study the flow of groundwater were examined. The potential of recharge wells is not confined to the alternative they offer to open infiltration. Infiltrating pretreated surface water into the ground limits the impact of groundwater withdrawal on the environment and of the environment on groundwater withdrawal. (Baker-IVI)
W86-00006

WATER RESOURCES ON THE PUEBLO OF LAGUNA, WEST-CENTRAL NEW MEXICO,
Geological Survey, Albuquerque, NM. Water Resources Div.
For primary bibliographic entry see Field 2F.
W86-00108

GROUND-WATER RESOURCES OF AUDRAIN COUNTY, MISSOURI,
Geological Survey, Rolla, MO. Water Resources Div.
For primary bibliographic entry see Field 2F.
W86-00113

GROUND-WATER CONDITIONS IN THE COTTONWOOD-WEST OAKLEY FAN AREA, SOUTH-CENTRAL IDAHO,
Geological Survey, Boise, ID. Water Resources Div.
For primary bibliographic entry see Field 2F.
W86-00117

AVAILABILITY OF WATER FROM THE ALLUVIAL AQUIFER IN PART OF THE GREEN RIVER VALLEY, KING COUNTY, WASHINGTON,
Geological Survey, Tacoma, WA. Water Resources Div.
For primary bibliographic entry see Field 2F.
W86-00126

WATER RESOURCES DATA, NORTH DAKOTA, WATER YEAR 1981, VOLUME 1. HUDSON BAY BASIN,
Geological Survey, Bismarck, ND. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-00129

## 4C. Effects On Water Of Man's Non-Water Activities

HISTORICAL CHANGES TO LAKE WASHINGTON AND ROUTE OF THE LAKE WASHINGTON SHIP CANAL, KING COUNTY, WASHINGTON,
Geological Survey, Seattle, WA. Water Resources Div.
For primary bibliographic entry see Field 2H.
W86-00105

OIL SHALE MINING, PROCESSING, USES, AND ENVIRONMENTAL IMPACTS, 1978-JULY, 1981: CITATIONS FROM THE NTIS DATA BASE,
National Technical Information Service, Springfield, VA.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-801357. December 1982. 271 p.

Descriptors: *Bibliographies, *Oil shale, *Industrial wastes, *Mine wastes, *Wastewater treatment, *Water pollution control, *Water quality control, Gasification, Pollutant identification, Leachates, Shales, Environmental effects, Ecological effects, Groundwater pollution, Streams, Aquifers, Water requirements.

This bibliography contains 366 abstracts of government-funded research on oil shale. Among the water-related subjects are water pollution control, waste and wastewater characterization and treatment, leachates, effect on groundwater and stream-water quality, health hazards, revegetation of disturbed soils, groundwater monitoring, environmental and ecological impacts, geochemistry, social and economic impacts, hydraulic fracturing, hydrologic aspects, and water consumption.
W86-00201

## 4D. Watershed Protection

EVALUATION OF A HYDROGRAPH SHIFTING METHOD FOR ESTIMATING SUSPENDED-SEDIMENT LOADS IN ILLINOIS STREAMS,
Geological Survey, Urbana, IL. Water Resources Div.
For primary bibliographic entry see Field 2J.
W86-00115

EVALUATION OF HYDROLOGIC PROCESSES AFFECTING SOIL MOVEMENT IN THE HAGERMAN FAUNA AREA, HAGERMAN, IDAHO,
Geological Survey, Boise, ID. Water Resources Div.
For primary bibliographic entry see Field 2G.
W86-00119

BUHNE POINT, HUMBOLDT BAY, CALIFORNIA, DESIGN FOR THE PREVENTION OF SHORELINE EROSION: HYDRAULIC AND NUMERICAL MODEL INVESTIGATIONS,
Coastal Engineering Research Center, Vicksburg, MS.
R. R. Bottin, and J. A. Earickson.
Technical Report CERC-84-5, November 1984. Final Report. 336 p, 14 Fig, 17 Tab, 142 Photos, 78 Plates, 26 Ref, 2 Append.

Descriptors: *Model studies, *Erosion control, *Beach erosion, *Structural models, *Hydraulic models, Channel erosion, Design criteria, Models, Numerical analysis, Jetties, Sediment transport, Breakwaters.

Two numerical and two physical models were used to study the effects of proposed improvement plans to rectify shoreline erosion at Buhne Point, Humboldt Bay. The numerical tidal circulation model showed that changes in tidal current velocities and flow patterns will be minimal due to proposed improvements. The numerical sediment transport model (CELC3D) showed that no new sediment transport patterns are induced by the optimum improvement plan. The 1:100-scale physical model of central Humboldt Bay showed that, regardless of the incident wave approach from the Pacific Ocean, the angle of the wave front in the vicinity of Buhne Point remains essentially the same. This same model also indicated that test waves directly up the axis of the channel result in significantly larger wave heights in the vicinity of Buhne Point. The 1:50-scale physical model of Buhne Point was used to determine the cause of erosion at the point and the effectiveness of the various structures proposed for protection. Results showed that wave energy approaching the point from the jettied entrance to the bay eroded the original spit. Sediment eroded from the eastern part of the shoal and migrated westwardly where it entered the navigation channel. A reverse curve in the shore-connected breakwater where it originates from the existing Buhne Drive revetment (optimum plan) minimized wave convergence and runup in this area.
W86-00169

ANSWERS (AREAL NONPOINT SOURCE WATERSHED ENVIRONMENT RESPONSE SIMULATION) USER'S MANUAL,
Purdue Univ., Lafayette, IN. Dept. of Agricultural Engineering.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-115436. EPA-905/9-82-001, December 1981. Environmental Protection Agency, Chicago, IL. Great Lakes National Program Office. 54 p, 16 Fig, 3 Tab, 26 Ref, 4 Append. Contract/Grant No. EPA-G005335.

Descriptors: *Fate of pollutants, *Erosion control, *Soil conservation, *Model studies, *Watershed

management, *Nonpoint pollution sources, Agricultural watersheds, Mathematical models, ANSWERS model, Sediment transport, Hydrology, Land use, Sedimentation, Rainfall rate, Infiltration, Conservation.

This report is an expanded and edited version of the Users Manual for the ANSWERS (Areal Nonpoint Source Watershed Environment Response Simulation) model, first published in September, 1980. ANSWERS is a distributed parameter model capable of predicting the hydrologic and erosion response of primarily agricultural watersheds. Particle-size distributions of the eroded sediment (at all points in the watershed, as well as the outlet) are available. The manual provides insights into model concepts, input requirements, output interpretation, and planning applications. (Author)
W86-00287

# 5. WATER QUALITY MANAGEMENT AND PROTECTION

## 5A. Identification Of Pollutants

**ANALYSIS OF PHENOLS BY CHEMICAL DERIVATIZATION. IV. RAPID AND SENSITIVE METHOD FOR ANALYSIS OF 21 CHLOROPHENOLS BY IMPROVED CHLOROACETYLATION PROCEDURE,**
Canada Centre for Inland Waters, Burlington (Ontario).
H.-B. Lee, R. L. Hong-You, and A. S. Y. Chau.
Journal of the Association of Official Analytical Chemists, Vol. 68, No. 3, p 422-426, 1985. 3 Fig, 2 Tab, 22 Ref.

Descriptors: *Phenols, *Chlorophenols, *Chloroacetylation, *Water analysis, Chloracetic anhydride, Chemical analysis, Organic compounds, Gas chromatography, Chlorinated hydrocarbons.

A quantitative, rapid, sensitive, and isomer-specific method for the analysis of chlorophenols in natural water by in situ chloroacetylation was developed. Without pre-extraction, phenols in water are chloroacetylated by chloroacetic anhydride in the presence of $K_2CO_3$. Because of differences in reaction kinetics and stability, various chloroacetates were removed from the reaction mixture at different intervals. A more elaborate procedure was developed for cases where analysis of other classes of neutral organic compounds is also required; the procedure involves solvent extraction of organic compounds and back-extraction of phenols into $K_2CO_3$ solution followed by chloroacetylation. When a 12 m OV-1 fused silica capillary column was used, 22 phenol chloroacetates were easily resolved in a single run. Using distilled and natural water samples, this method has been validated and shown to be applicable over a concentration range of 0.1 to 100 micro-g/L of the phenols studied. (Author's abstract)
W86-00002

**MULTIRESIDUE METHOD FOR THE ANALYSIS AND VERIFICATION OF SEVERAL HERBICIDES IN WATER,**
Department of Agriculture, Regina (Saskatchewan). Research Station.
A. J. Cessna, R. Grover, L. A. Kerr, and M. L. Aldred.
Journal of Agricultural and Food Chemistry, Vol. 33, No. 3, p 504-507, 1985. 2 Fig, 3 Tab, 11 Ref.

Descriptors: *Pesticide residues, *Herbicides, *Chemical analysis, *Detection limits, Water analysis, 2,4-D, Bromoxynil, Dicamba, MCPA, Picloram, Triallate, Trifluralin, Gas chromatography.

Because of the diversity of herbicide products available, environmental water samples would best be analyzed for herbicide residues by using a multiresidue procedure. A multiresidue analytical method to determine and verify residues of both neutral and acidic herbicides in water was developed. Acidic herbicides were derivatized by using diazomethane. Recoveries of herbicides (bromoxynil, 2,4-D, dicamba, MCPA, picloram, triallate, and trifluralin) from distilled water at fortification levels of 0.1-1 ppb ranged from 80 to 117%. Except for MCPA, all other herbicide residues could be verified by using two different detector modes. The method was used in a preliminary study to monitor herbicide residues in irrigation return flow waters at the Outlook Irrigation District (Saskatchewan). The supply water from the pumping station, monitored to provide background interferences for the various herbicides, consistently showed trace interferences at the retention time for 2,4-D which were less than the limit of detection. For the first two weeks of sampling, these interferences in the return flow water samples from the drainage ditches reflected what was found in the supply water. The average background interference in the 2,4-D region of the chromatogram was 0.13 ppb whereas those for the dicamba and bromoxynil regions were less than 0.1 ppb in both the supply water and in drainage ditch water prior to the commencement of spraying which occurred after the June 4 sampling; these backgrounds still permitted a limit of detection of 0.5 ppb for all three herbicides. The background interferences in the trifluralin and triallate regions readily permitted a limit of detection of 0.1 ppb. The method showed good reproducibility between duplicate water samples and these residues could be readily confirmed by using a specific gas chromatographic detector (the Hall detector in the halogen mode). (Collier-IVI)
W86-00046

**RAPIDITY OF RNA SYNTHESIS IN HUMAN CELLS; A HIGHLY SENSITIVE PARAMETER FOR WATER CYTOTOXICITY EVALUATION,**
Service de Controle des Eaux de la Ville de Paris (France).
C. Fauris, C. Danglot, and R. Vilagines.
Water Research, Vol. 19, No. 6, p 677-684, 1985. 5 Fig, 3 Tab, 25 Ref.

Descriptors: *RNA synthesis, *Cytotoxicity testing, *Toxicity testing, *Water pollution effects, *Seine river, *Marne river, *Oise river, *France, Water analysis, Enzymes, Cell physiology, Animal physiology, Animal metabolism.

Effects of several water pollutants were tested, without any concentration, on the main cellular metabolic pathways of cultured human cells. The cellular targets studied were divided into four groups: the microsome and cytosol enzymes group (alkaline phosphatase, uridine kinase, thymidine kinase and ATPase); the mitochondrial enzymes group (ATPase and cytochrome oxidase); the isolated nuclei group (1 function); and the viable cells group (cytoplasmic membrane permeability and protein, RNA, and DNA synthesis). Each enzymatic activity or cellular function was tested in the presence of increasing concentrations of potassium dichromate, potassium cyanide, phenol, actinomycin D, sodium dodecyl sulfate, Triton X-100, and cupric sulfate. This comparison clearly indicated that the rapidity of cellular RNA synthesis was the most sensitive target to many pollutants. When used in the water field this quantitative test does not require preliminary concentration of the water's toxic compounds and, in the case of polluted river waters, requires sample dilution. Response of the test is fast enough to require only a 2 h incubation for highly cytotoxic samples and 20 h incubation for samples of low cytotoxicity. Its simplicity makes it easily adaptable to routine analysis and continuous monitoring of any water. Weekly cytotoxicity determinations were performed for two months on the river Seine at different sampling points around Paris (France) and on the river Marne and the river Oise. Chemical and physical tests were performed on the samples as well. The classification obtained by the whole of physicochemical analysis correlated well with the cytotoxicity testing. The application domain of the test is very large, ranging from surface and ground waters to drinking and bottled mineral waters. (Collier-IVI)
W86-00052

**TRACER APPLICATIONS OF ULTRA-VIOLET ABSORPTION MEASUREMENTS IN COASTAL WATERS,**
University Coll. of North Wales, Menai Bridge. Marine Science Labs.
For primary bibliographic entry see Field 2L.
W86-00056

**ESTIMATION OF PHOSPHORUS FLUX IN A REGULATED CHANNEL,**
Inland Waters Directorate, Vancouver (British Columbia). Water Quality Branch.
L. J. Zeman, and H. O. Slaymaker.
Water Research, Vol. 19, No. 6, p 757-762, 1985. 3 Fig, 19 Ref.

Descriptors: *Phosphorus flux, *Okanagan River, *British Columbia, *Regulated flow, Nutrients, Annual distribution, Water sampling, Sampling strategy, Nutrient flux, Load distribution.

During a nutrient loading study in the Okanagan River Basin, British Columbia, the regression relationship between phosphorus concentrations and the Okanagan River discharge was shown to be not statistically significant. Phosphorus flux could, therefore, not be determined by conventional methods which rely on the concentration-discharge relationship. The reason for failure of conventional methods is the regulated nature of the Okanagan River flow. Two sampling strategies for chemical analysis of water samples were applied: (a) simultaneous, based on manual collection of sample replicates; and (b) sequential, using an automatic device to obtain a series of point concentration measurements. These sampling strategies provided a basis for nutrient flux estimation by the following methods; (a) partial load method, resulting from simultaneous sampling; and (b) flow interval method, based on sequential sampling. Load estimates and their confidence limits derived from the partial load method were compared with loads obtained by the flow interval method. There was a high level of correlation between the load estimates. Annual trends are more appropriately investigated by the flow interval method, cross-sectional load variability and confidence limits should be assessed by the partial load method. (Author's abstract)
W86-00062

**ASSESSMENT OF HEAVY METALS AND PCB'S AT SELECTED SLUDGE APPLICATION SITES IN ONTARIO,**
Department of the Environment, Ottawa (Ontario).
M. D. Webber, H. D. Monteith, and G. M. Corneau.
Environment Canada, Canada-Ontario's Agreement on Great Lakes Water Quality, Research Report No. 109, 1981. 27 p, 2 Fig, 10 Tab, 16 Ref.

Descriptors: *Fate of pollutants, *Bioaccumulation, *Sludge disposal, *Sludge utilization, *Grain crops, *Heavy metals, *Polychlorinated biphenyls. *Plant tissues, Path of pollutants, Land disposal, Metals, Cadmium, Zinc, Waste disposal, Molybdenum, Corn, Wheat, Oats, Ruminants, Solid waste disposal.

Ten sludge application sites were sampled during the summers of 1976 and 1978 for PCB and metal concentrations in soil and plants. Determinations of PCB and metal loadings showed that metal loadings exceeded the maxima recommended in the Ontario Sludge Utilization Guidelines at several sites. Sludge application increased the total metal and PCB contents and the DTPA-extractable metals in the soils. The largest increases generally coincided with the largest estimated loadings. The effects of sludge application on plants were minimal, except for an increase of Cd and Zn contents in plant materials. Stratford sludge contributed a heavy Mo loading and greatly increased the Mo content of corn leaves at that site. An exclusive diet of corn leaves from the Stratford site would cause Mo-induced Cu deficiency in ruminant animals. Increased Zn concentrations in plants would be desirable because Zn is usually deficient in plant and animal nutrition. However, increased Cd

levels are undesirable because of the metal's toxicity to both plants and animals. Sludge application to land according to the Ontario Guidelines will not cause deleterious uptake of heavy metals by corn, oats and wheat.
W86-00102

**WATER-QUALITY APPRAISAL, MAMMOTH CREEK AND HOT CREEK, MONO COUNTY, CALIFORNIA,**
Geological Survey, Sacramento, CA. Water Resources Div.
J. G. Setmire.
Available from the OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4060, 1984. 50 p, 15 Fig, 15 Tab, 6 Ref.

Descriptors: *Eutrophication, Dissolved oxygen, *Algal growth, *Mineralization, Nitrates, *Sedimentation, *Bacteria, *California, Mammoth Creek, Hot Creek, Mono County, *Mammoth Lakes.

A late summer reconnaissance in 1981 and a spring high-flow sampling in 1982 of Mammoth Creek and Hot Creek, located in the Mammoth crest area of the Sierra Nevada, indicated that mineralization, eutrophication, sedimentation, and limited areas of fecal contamination were occurring. Mineralization, indicated by a downstream increase in dissolved-solids concentration, was due primarily to geothermal springs that gradually decreased in the percentage of calcium, increased in the percentage of magnesium and sodium, and caused fluctuating, but overall increasing percentage of fluoride, sulfate, and chloride. Resulting water quality in Mammoth Creek was similar to that of the springs forming Hot Creek. Eutrophication was observed in Twin Lakes and the reach of Hot Creek below the fish hatchery. Twin Lakes had floating mats of algae and a high dissolved-oxygen saturation of 147 percent at a pH of 9.2. Hot Creek had excessive aquatic vascular plant and algae growth, dissolved-oxygen saturations ranging from 65 to 200 percent, algal growth potential of 30 milligrams per liter, and nitrates and phosphates of 0.44 and 0.157 milligrams per liter. Sedimentation was noted in observations of bed-material composition showing the presence of fine material beginning at Sherwin Creek Road. Fecal contamination was indicated by fecal coliform counts of 250 colonies per 100 milliliters and fecal streptococcal counts greater than 1,000 colonies per 100 milliliters. (USGS)
W86-00106

**HYDROGEOLOGIC AND WATER-QUALITY CHARACTERISTICS OF THE MOUNT SIMON-HINCKLEY AQUIFER, SOUTHEAST MINNESOTA,**
Geological Survey, St. Paul, MN. Water Resources Div.
For primary bibliographic entry see Field 2K.
W86-00109

**QUALITY OF WATER, QUILLAYUTE RIVER BASIN, WASHINGTON,**
Geological Survey, Tacoma, WA. Water Resources Div.
For primary bibliographic entry see Field 2K.
W86-00111

**INVESTIGATION OF WAIKELE WELL NO. 2401-01, OAHU, HAWAII: PUMPING TEST, WELL LOGS AND WATER QUALITY,**
Geological Survey, Honolulu, HI. Water Resources Div.
For primary bibliographic entry see Field 2K.
W86-00118

**ASSESSMENT OF WATER RESOURCES IN LEAD-ZINC MINED AREAS IN CHEROKEE COUNTY, KANSAS, AND ADJACENT AREAS,**
Geological Survey, Lawrence, KS. Water Resources Div.
T. B. Spruill.
Available from the OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Open-File Report 84-439, (1984). 102 p, 23 Fig, 26 Tab, 35 Ref.

Descriptors: *Mine drainage, *Groundwater contamination, *Stream pollution, *Groundwater hydrology, Water quality, *Water quantity, *Kansas, Cherokee, Lead and zinc mines.

A study was conducted to evaluate water-resource problems related to abandoned lead and zinc mines in Cherokee County, and adjacent areas in Oklahoma and Missouri. Discontinuities and perforations, which were produced by mining in the confining shale west of the Pennsylvanian-Mississippian geologic contact, have created artificial groundwater recharge and discharge areas. Abandoned wells and drill holes present the greatest contamination hazard to water supplies in the deep aquifer. There is a potential for downward movement from the shallow to the deep aquifer throughout the study area, with greatest potential in Ottawa County, Oklahoma. Principal effects of abandoned mines on groundwater quality are lowered pH and increased concentrations of sulfate and trace metals of water in the mines. No conclusive evidence of lateral migration of contaminated mine water from the mines into the water-supply wells adjacent to the mines was found. Analyses of water from the deep aquifer did not indicate trace-metal contamination. The effects of abandoned mines on streamwater quality are most severe in Short Creek and Tar Creek. Increased concentrations of zinc and manganese were observed in the Spring River below Short Creek Kansas. (USGS)
W86-00121

**TREND ANALYSIS OF SALT LOAD AND EVALUATION OF THE FREQUENCY OF WATER-QUALITY MEASUREMENTS FOR THE GUNNISON, THE COLORADO, AND THE DOLORES RIVERS IN COLORADO AND UTAH,**
Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 5B.
W86-00123

**WATER RESOURCES DATA, NORTH DAKOTA, WATER YEAR 1981, VOLUME 1. HUDSON BAY BASIN.**
Geological Survey, Bismarck, ND. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-00129

**CHEMISTRY FOR OPERATORS,**
Muskegon County Board, MI. Dept. of Public Works.
For primary bibliographic entry see Field 5F.
W86-00134

**LABORATORY PROTOCOLS FOR EVALUATING THE FATE OF ORGANIC CHEMICALS IN AIR AND WATER,**
SRI International, Menlo Park, CA.
T. Mill, W. R. Mabey, D. C. Bomberger, T.-W. Chou, and D. G. Hendry.
EPA-600/3-82-022, July 1982. Environmental Research Laboratory, Athens, GA. 329 p, 21 Fig, 46 Tab, 287 Ref. Contract/Grant No. 68-03-2227.

Descriptors: *Fate of pollutants, *Testing procedures, *Air pollution, *Water pollution, *Organic compounds, Biotransformation, Oxidation, Aquatic habitats, Hydrolysis, Photolysis, Sorption.

Laboratory test procedures (or protocols) have been developed to provide data useful in evaluating the environmental fate of organic compounds in natural aquatic systems and in the atmosphere. Screening-level protocols are described to estimate rate constants for hydrolysis, photolysis, oxidation, biotransformation, volatilization processes in natural aquatic systems, and a screening protocol for measurement of partition coefficients for sorption of organic chemicals to sediments is also described. Detailed test protocols have been developed for the hydrolysis, photolysis, volatilization, and sediment-sorption processes to obtain more accurate and precise data for use in enviromental assessments applied to aquatic systems. Screening and detailed test protocols are described for estimating rate constants for the atmospheric photolysis and oxidation of organic compounds. For each process, the theory and the present state of knowledge regarding the environment are reviewed, and some common methods currently in use are critically evaluated. (Author)
W86-00154

**MICROBIOLOGICAL WATER QUALITY OF IMPOUNDMENTS: A LITERATURE REVIEW,**
Texas Univ. at Dallas, Richardson. Graduate Program in Environmental Sciences.
G. A. Burton.
Miscellaneous Paper E-82-6, December 1982. Final Report. U.S. Army Environmental and Water Quality Operational Studies, Army Engineer Waterways Experiment Station, Vicksburg, MS. 53 p, 5 Tab, 210 Ref.

Descriptors: *Pollutant identification, *Water analysis, *Literature review, *Sampling, *Water quality, *Reservoirs, *Microbiologial studies, *Bacterial analysis, Water sampling, Indicators, Bioindicators, Coliforms, Public health, Diseases, Pathogens, Parasites, Viruses.

Assessing the microbiological water quality of impoundments and the potential for waterborne disease outbreaks is a difficult task when using traditional sampling programs. Problems associated with using fecal coliform bacteria as indicators of human pathogen presence complicates assessments of future water quality in preimpoundment areas. Reliable determination of future and present microbiological water quality requires knowledge of how the chemical, physical, and biological characteristics of the watershed and impoundment interrelate to influence microbial indicator and pathogen densities. Accurate estimates of microbial indicator and pathogen densities, obtainable by using the enumeration methods and their modifications suggested in this report, will allow monitoring of the proper indicator organisms and estimation of potential sites of pathogen occurrence, density, and survival. Sampling programs must be geared toward critical time periods and areas; i.e., summer months, storm flows, feeder streams, agricultural and urban runoff, and swimming areas, including water and sediments. Frequency of sampling should be dictated by variability of water conditions, confidence level of data, and extent of human contact. Choice of proper indicator organisms and enumeration methods and appropriate sampling strategies will allow sound preimpoundment assessment and reservoir management to greatly reduce the risk of waterborne disease outbreaks. (Author)
W86-00185

**PROCEDURES FOR HANDLING AND CHEMICAL ANALYSIS OF SEDIMENT AND WATER SAMPLES,**
State Univ. of New York Coll. at Buffalo. Great Lakes Lab.
R. H. Plumb.
Technical Report EPA/CA-81-1, May 1981. Army Engineer Waterways Experiment Station, Vicksburg, MS. 482 p, 52 Fig, 32 Tab, 44 Ref. Contract/Grant No. EPA-4805572010.

Descriptors: *Pollutant identification, *Chemical analysis, *Sediments, *Sampling, *Water analysis, Sample preparation, Sample preservation, Bottom sampling, Dredging, Organic compounds, Cation exchange capacity, Particle size, Hydrogen ion concentration, Oxidation-reduction potential, Inorganic compounds, Carbon, Metals, Nitrogen compounds, Ammonia, Phosphates, Sulfides, Carbamates, Chlorinated hydrocarbons, Oil, Pesticides, Insecticides, Herbicides, Phenolic compounds, Biochemical oxygen demand, Chemical oxygen demand, Sediment oxygen demand, Oxygen demand.

This handbook provides guidance for sampling, preservation, and analysis of dredged and fill material. Its emphasis is on regulatory affairs rather than research. Section 1 shows a project manager

the trade-offs involved in developing a sampling program. Factors which must be considered are sampling locations, sampling equipment, number of samples, types of tests, and specific chemical analyses. Section 2 shows laboratory and field personnel how to implement the sampling program. This includes the sample equipment and handling as well as the three general chemical tests: standard elutriate test, bulk analysis, and sediment fractionation. Section 3 gives details of analytical techniques for 44 parameters, including physical analysis (cation exchange capacity, particle size, pH, oxidation reduction potential, total and volatile solids, specific gravity), inorganic analysis (carbon, metals, nitrogen and compounds, phosphates, sulfides), organic analysis (carbamates, herbicides, insecticides, oil/grease, phenolics), chlorine demand, biochemical oxygen demand, chemical oxygen demand, and sediment oxygen demand.
W86-00198

**MICROCOMPUTER ASSISTED QUALITY ASSURANCE,**
Lotic Enterprises, Bakersfield, CA.
G. Hill.
1984, 106 p.

Descriptors: *Pollutant identification, *Wastewater treatment, *Water analysis, *Computer programs, *Quality control, *Statistical methods, Bacterial analysis, Chemical analysis, Physical analysis, Sampling, Standards, Standard deviation, Correlation analysis, Equations, Error analysis, Precision, Detention time, Corrosion, Larson/Langlier saturation index, Saturation index, Metric system, Mathematical studies.

Computer programs written in BASIC are given for quality assurance programs in water analysis and wastewater treatment laboratories. Each computer program includes a program description, documentation which the user must enter, the definition of variables, an example, a run, and a listing of the program. Some of the programs are organization of samples, typical report forms, internal standard method, standard addition (for determining low levels of the analyte), standard deviation, control charts, linear correlation coefficient, equation of the straight line, linear regression, linear interpolation from a single point, atomic absorption detection limits, percent recovery, mean error accuracy, anion-cation balance, feed rates, detention times, corrosive tendency, Larson/Langelier saturation index, and metric unit conversion.
W86-00203

**METHODS FOR ECOLOGICAL TOXICOLOGY: A CRITICAL REVIEW OF LABORATORY MULTISPECIES TESTS.**
Oak Ridge National Lab., TN. Environmental Sciences Div.
For primary bibliographic entry see Field 5C.
W86-00210

**MONITORING MARINE MICROBIAL FOULING.**
National Aeronautics and Space Administration, Huntsville, AL. George C. Marshall Space Flight Center.
Technical Support Package, MFS-25928, Spring 1984. 23 p, 1 Tab.

Descriptors: *Pollutant identification, *Microorganisms, *Fouling, *Bacterial analysis, *Microbiological studies, Microscopy, Films.

A method for monitoring biofouling on metal surfaces and nylon parachute material immersed in seawater was developed. It involves a combination of scanning electron microscopy and isolation, enumeration, and identification of biofouling microorganisms, using standard microbiological culture methods. Marine biofouling increases with length of exposure of the water and with water temperature. The polysulfide sealant and nylon parachute material were more readily biofouled than metallic surfaces. Spray washing was not effective for removing deposits of organic biofilm.
W86-00227

**SAMPLING FREQUENCY - MICROBIOLOGICAL DRINKING WATER REGULATIONS: FINAL REPORT,**
Drexel Univ., Philadelphia, PA. Dept. of Biological Sciences.
W. O. Pipes, and R. R. Christian.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-127738. EPA/570/9-82-001, September 1982. Environmental Protection Agency, Washington, DC. Office of Drinking Water. 174 p, 22 Fig, 70 Tab, 25 Ref, Append.

Descriptors: *Pollutant identification, *Water analysis. *Water distribution, *Sampling, *Bacteria, Coliforms, Microorganisms, Monitoring, Microbiological studies.

A sampling model was developed to specify the sampling frequency needed to determine compliance with the microbiological maximum contaminant levels of the Natinal Interim Primary Drinking Water Regulations. Two approaches were used: empirical, based on fitting coliform data to frequency distributions; and mechanistic, done by analyzing the physical elements of the system to determine the distribution of coliforms throughout a water system. In the empirical approach the truncated lognormal distribution was chosen. In this case coliform densities $< 1/100$ ml or $> 80/100$ ml cannot be measured. The probability of violation is a function of the densities of coliforms, the number of samples collected, and the parameters of the lognormal distribution. Therefore a higher degree of aggregation of coliform bacteria leads to larger numbers of samples being needed for detection of contamination. The mechanistic approach showed that the water distribution system could be divided into hydraulically isolated sections. It was concluded that all sections must be included in the monitoring program to get an accurate measure of coliform occurrence. Coliform occurrence did not differ between peripheral and nonperipheral locations or with distance from the water source. Thus sampling locations for a microbiological monitoring program can be selected on a randomized basis.
W86-00245

**ADDENDUM TO HANDBOOK FOR SAMPLING AND SAMPLE PRESERVATION.**
Environmental Monitoring and Support Lab.-Cincinnati, OH.
EPA-600/4-83-039, August 1983, 28 p, 3 Tab.

Descriptors: *Water analysis, *Pollutant identification, *Sampling, *Water sampling, *Sample preparation, *Monitoring, Sample preservation, Preservation, Monitoring, Water analysis.

This addendum has an updated and expanded Table 2.3, listing automatic samplers and their characteristics. In addition, the definitions of sample types (discrete, composite, flow proportional composite, hand proportioned composite, sequential composite, and continuous composite) have been revised. Additional references on samplers and sampling are listed.
W86-00268

**SAMPLING AND DETECTION OF TAGGED DREDGED MATERIAL,**
Argonne National Lab., IL. Energy and Environmental Systems Div.
L. S. Van Loon, D. L. McCown, and J. D. Ditmars.
Available from the National Technical Information Service, Springfield, VA 22161 as DE82016056. ANL/EES-TM-169, January 1982. 29 p, 17 Fig, 5 Ref. Contract/Grant No. W-31-109-Eng-38.

Descriptors: *Pollutant identification, *Dredging, *Sediment transport, Sand, Sampling, Ultraviolet radiation, Fluorescence.

Systems for sampling and detecting tagged dredged sand in the Upper Mississippi River were develped by Argonne National Laboratory for the U.S. Army Corps of Engineers, Rock Island District. The Corps plans to demonstrate main-channel disposal of dredged material, and it requires systems to detect the movement of the dredged material after the material has been placed in a deep reach of river. The dredged material in the demonstration will be tagged with sand particles coated with fluorescent dye. Argonne designed systems for sampling of the bottom surficial sediments at discrete points along transects from a boat that employs a precision navigation system; onboard visual inspection of the samples for dyed sand in an ultraviolet light box; and photography of ultraviolet-illuminated samples. This report describes the systems and their uses as well as the results of tests to determine proper settings for photographic equipment. (Author)
W86-00288

## 5B. Sources Of Pollution

**AVERAGE RAINWATER PH, CONCEPTS OF ATMOSPHERIC ACIDITY, AND BUFFERING IN OPEN SYSTEMS,**
Texas Univ. at Austin. Dept. of Environmental Health Engineering.
H. M. Liljestrand.
Atmospheric Environment, Vol. 19, No. 3, p 487-499, 1985. 4 Fig, 2 Tab, 24 Ref, 2 Append. EPA grant R810148-01 and California Air Resources Board grant A7-110-30.

Descriptors: *Acid rain, *Chemistry of precipitation, *Hydrogen ion concentration, *Chemical reactions, *Buffering, Carbon dioxide, Ammonia, Hydrochloric acid, Nitrates, Sulfur dioxide, Carbonate, Air pollution.

The system of water equilibrated with a constant partial pressure of $CO_2$, as a reference point for pH acidity-alkalinity relationships, has nonvolatile acidity and alkalinity components as conservative quantities, but not $H(+)$ concentration. Simple algorithms were developed for the determination of the average pH for combinations of samples both above and below pH 5.6. Averaging the nonconservative quantity $H(+)$ concentration yields erroneously low mean pH values. To extend the open $CO_2$ system to include other volatile atmospheric acids and bases distributed among the gas, liquid and particulate matter phases, a theoretical framework for atmospheric acidity was developed. Within certain oxidation-reduction limitations, the total atmospheric acidity (but not free acidity) is a conservative quantity. The concept of atmospheric acidity was applied to air-water systems approximating aerosols, fogwater, cloudwater and rainwater. The buffer intensity in hydrometeors is a function of net strong acidity, partial pressures of acid and base gases and the water to air ratio. For high liquid to air volume ratios, the equilibrium partial pressures of trace acid and base gases are set by the pH or net acidity controlled by the nonvolatile acid and base concentrations. For low water to air volume ratios as well as stationary state systems such as precipitation scavenging with continuous emissions, the partial pressures of trace gases ($NH_3$, HCl, $HNO_3$, $SO_2$ and $CH_3COOH$) appear to be of greater or equal importance as carbonate species as buffers in the aqueous phase. (Author's abstract)
W86-00001

**CHLORINATED ORGANICS IN SIMULATED GROUNDWATER ENVIRONMENTS,**
Florida International Univ., Miami. Drinking Water Research Center.
F. Parsons, and G. B. Lage.
Journal of the American Water Works Association, Vol. 77, No. 5, p 52-59, May, 1985. 9 Fig, 7 Tab, 27 Ref.

Descriptors: *Chlorinated hydrocarbons, *Groundwater, *Biotransformation, *Degradation, Biodegradation, Fate of pollutants, Trichloroethane, Tetrachloromethane, Trichlormethane, Dichloroethane.

Tetrachloromethane and 1,1,1-trichloroethane were transformed in microcosms composed of aquifer materials to trichloromethane and 1,1-dichloroethane, respectively. Further observations of tri- and tetrachloroethane in microcosms demonstrated

the transformation of these compounds to dichloroethane. Biotransformation products of these four solvents by freshwater sediment microbiota, in sealed static microcosms, were determined by gas chromatography during incubation at ambient temperatures in the dark for periods of up to 16 weeks. Under conditions of neutral to acid pH, reductive potential, and the absence of oxygen and light, reductive dehalogenation of these four compounds occurred. Chlorinated alkenes were consistently more resistant to biotransformation than the chlorinated alkanes. (Author's abstract)
W86-00007

**AWWA SURVEY OF INORGANIC CONTAMINANTS IN WATER SUPPLIES.**
For primary bibliographic entry see Field 5F.
W86-00009

**SURFACE BUOYANT JETS IN STEADY AND REVERSING CROSSFLOWS,**
Worcester Polytechnic Inst., Holden, MA. Alden Research Labs.
D. N. Brocard.
Journal of Hydraulic Engineering, Vol. 111, No. 5, p 793-809, May, 1985. 10 Fig, 2 Tab, 19 Ref.

Descriptors: *Buoyant jets, *Crossflows, *Plumes, *Heated water, Path of pollutants, Buoyant spreading, Boundary effects, Water currents.

Data on suface buoyant jets in steady and reversing crossflows was obtained with experiments conducted in a 130 ft (40 m) by 81 ft (25 m) by 1.5 ft (0.45 m) deep basin, which was large enough to ensure negligible boundary effects while allowing controlled ambient conditions. The test results are presented nondimensionally and referenced to controlling length scales. The steady crossflow results are trajectories and longitudinal temperatures, which show the effects of the discharge buoyancy and initial flow rate. Comparing these results with those of other experimental studies leads to the suspicion that boundary effects may be present in some of the latter. The reversing crossflow tests furnish surface temperature patterns and plume depths for a range of conditions. These results can be used to evaluate mathematical models. In addition, the effects of tidal reversal on the offshore extent and depth of the plume are examined. Dispersion tests reveal that buoyancy played an important role in plume spreading. This factor is important as buoyant spreading is frequently omitted in two dimensional farfield mathematical models of thermal plumes. (Author's abstract)
W86-00014

**DISPERSION IN ANISOTROPIC, HOMOGENEOUS, POROUS MEDIA,**
Baghdad Univ. (Iraq). Coll. of Engineering.
For primary bibliographic entry see Field 2F.
W86-00015

**INITIAL DILUTION FOR OUTFALL PARALLEL TO CURRENT,**
Monash Univ., Clayton (Australia). Dept. of Mechanical Engineering.
J. B. Hinwood, and I. G. Wallis.
Journal of Hydraulic Engineering, Vol. 111, No. 5, p 828-845, May, 1985. 7 Fig, 2 Tab, 10 Ref, 2 Append. Australian National Energy Research Development and Demonstration Council grant 78/2799.

Descriptors: *Outfalls, *Dilution, *Currents, *Diffusers, Thermal pollution, Wastewater outfall, Plumes, Buoyancy.

Rotary tidal currents or site constraints can result in an outfall diffuser being alined with the current in shallow water. Experiments using a small model laboratory diffuser flume and a much larger scale model in an estuarine channel were used to establish the significant processes causing initial dilution of effluent discharged from a multiport diffuser alined parallel to the ambient current. From considerations of momentum conservation and mixing, and the results of the flume experiments, an expression for the initial dilution in shallow water was obtained the conditions defining shallow water were established. The results of the field experiments carried out in an estuarine channel were in agreement with the laboratory results and verified the derived expression. A relationship between the initial dilution and the angle between the diffuser and the current was developed from the field studies. (Author's abstract)
W86-00016

**REGIONAL UNSTEADY INTERFACE BETWEEN FRESH WATER AND SALT WATER IN A CONFINED COASTAL AQUIFER,**
Ehime Univ., Matsuyama (Japan). Dept. of Ocean Engineering.
For primary bibliographic entry see Field 2F.
W86-00042

**FATE OF ALDICARB, ALDICARB SULFOXIDE, AND ALDICARB SULFONE IN FLORIDAN GROUNDWATER,**
Florida Univ., Gainesville. Dept. of Environmental Engineering Sciences.
C. J. Miles, and J. J. Delfino.
Journal of Agricultural and Food Chemistry, Vol. 33, No. 3, p 455-460, 1985. 4 Fig, 3 Tab, 28 Ref.

Descriptors: *Aldicarb, *Pesticides, *Florida, *Groundwater contamination, *Fate of pollutants, Chemical reactions, Degradation, Hydrolysis, Limestone, Biodegradation, Microcosms.

The fate of aldicarb, aldicarb sulfoxide, and aldicarb sulfone in Floridan groundwater microcosms was determined. One reaction mechanism observed was base hydrolysis and degradation rates decreased in the order, sulfone > sulfoxide >> aldicarb. Appearance of oximes followed the disappearance of corresponding parent compounds while appearance of nitriles was minor and rarely observed. Microcosms amended with crushed limestone showed rates of hydrolysis that were 4-5 times slower than microcosms without limestone. Oxidation of aldicarb to the sulfoxide was minimal within 70 days whereas in separate experiments, the reduction of the sulfoxide to aldicarb was significant over the same time period. The sorption of aldicarb, aldicarb sulfoxide, and aldicarb sulfone onto limestone was not observed. (Author's abstract)
W86-00045

**LABORATORY AND FIELD STUDIES ON THE FATE OF 1,3,6,8-TETRACHLORODIBENZO-P-DIOXIN IN SOIL AND SEDIMENTS,**
Department of Fisheries and Oceans, Winnipeg (Manitoba). Freshwater Inst.
D. C. G. Muir, A. L. Yarechewski, R. L. Corbet, G. R. B. Webster, and A. E. Smith.
Journal of Agricultural and Food Chemistry, Vol. 33, No. 3, p 518-523, 1985. 1 Fig, 6 Tab, 21 Ref.

Descriptors: *Dioxins, *Sediments, *Soil, *Fate of pollutants, Degradation products, Carbon radioisotopes, Isotope studies, Lake sediments.

The fate of C-14-ring-labeled 1,3,6,8-tetrachlorodibenzo-p-dioxin (TCDD) was studied in sandy loam soil under field conditions and in silty-clay pond and lake sediments under laboratory conditions. Dissipation of 1,3,6,8-TCDD from small field plots was relatively rapid with 44% of the applied radioactivity lost after 131 days post-treatment. In sediment, 80% of the radioactivity could still be accounted for as intact chemical after 675 days under static aerobic conditions (10 and 25 C) or after 310 days under a nitrogen or air purge. Transformation of 1,3,6,8-TCDD to degradation products and unextractable radioactivity in soils and sediments was very slow. Unidentified polar products represented a maximum of 2.5% of extractable C-14 in field soils and 7.0% in sediments. DDT incubated in sediments under the same conditions had half-lives of < 310 days. (Author's abstract)
W86-00047

**HETEROTROPHIC SLIMES IN IRISH RIVERS, EVALUATION OF THE PROBLEM,**
Trinity Coll., Dublin (Ireland). Environmental Sciences Unit.
N. F. Gray, and C. A. Hunter.
Water Research, Vol. 19, No. 6, p 685-691, 1985. 2 Fig, 10 Tab, 14 Ref.

Descriptors: *Slimes, *Fungus, *Heterotrophic slimes, *Ireland, *Rivers, Surveys, Water pollution effects, Fish kills, Odors.

A questionnaire survey was used to determine the frequency of occurrence, extent and duration of slime growth in Irish rivers. Other factors such as the source of slime-promoting effluents, the degree of treatment given to effluents prior to discharge and the effects slime growth was having on watercourses were also examined. 156 outbreaks were recorded throughout Ireland which affected approx 350 km of channel. Discharges from the agricultural processing industry and domestic sewage were most frequently associated with slime outbreaks. Few of the outbreaks were insignificant in length with 33.7% in excess of 1 km and 13.5% in excess of 5 km. Although 12.6% of outbreaks resulted in no adverse effects on watercourses, major problems reported included the appearance and amenity value being adversely affected (86.4%), smell and deoxygenation (46.6%), damage to fish stocks (37.9%) and problems of sloughed flocs of slime (24.3%). The severity of these adverse effects was directly related to the length of outbreaks. The situation in Ireland was compared to England and Wales. (Author's abstract)
W86-00053

**GROUNDWATER SEEPAGE NUTRIENT LOADING IN A FLORIDA LAKE,**
Florida Inst. of Tech., Melbourne. Dept. of Environmental Sciences and Engineering.
For primary bibliographic entry see Field 2H.
W86-00065

**RELEASE OF ENDOTHALL FROM AQUATHOL GRANULAR AQUATIC HERBICIDE,**
North Texas State Univ., Denton. Dept. of Biological Sciences.
For primary bibliographic entry see Field 5G.
W86-00068

**ALTERNATING DIRECTION GALERKIN TECHNIQUE FOR SIMULATION OF CONTAMINANT TRANSPORT IN COMPLEX GROUNDWATER SYSTEMS,**
Waterloo Univ. (Ontario). Dept. of Earth Sciences.
A. D. Daus, and E. O. Frind.
Water Resources Research Vol. 21, No. 5, p 653-664, May, 1985. 14 Fig, 2 Tab, 20 Ref. Natural Sciences and Research Council of Canada operating grant A8368.

Descriptors: *Contamination, *Path of pollutants, *Solute transport, Finite element method, Computers, Simulation, Groundwater flow, Groundwater pollution.

A general contaminant transport simulation technique based on a Galerkin finite element representation in space and an alternating direction time-stepping scheme is developed. The formulation, which is in terms of natural coordinates following the principal directions of hydraulic conductivity of the medium, decouples the spatial components of the equations, leading to tridiagonal matrices. The numerical accuracy can be easily controlled in each principal direction through the well-established Peclet and Courant numbers. The ADG2 technique showed excellent potential for application to a variety of groundwater contamination scenarios. Applied to an isotropic, homogeneous system, it possesses the same favorable performance characteristis as the PD method of Frind and Pinder. These include delivery of equal or better accuracy compared with the conventional two-dimensional finite element technique; control over numerical dispersion through the Peclet and Courant criteria; independence of the numerical accuracy on the element aspect ratio; and low operations count, low core storage requirements, and

low solution roundoff error. The ADG2 technique possesses some distinct advantages over the P method; a grid that is invariant in time; applicability to transient flow conditions; and an ability to handle anisotropic flow systems and complex stratigraphy. The ADG2 technique retains both the flexibility of the finite element method and the efficiency of the alternative direction technique. Because of its simple structure and the absence of large banded matrices, the algorithm could provide a base for more complex modes such as those combining geochemical reactions with advective-dispersive transport. (Baker-IVI)
W86-00072

**ANALYSIS AND INTERPRETATION OF SINGLE-WELL TRACER TESTS IN STRATIFIED AQUIFERS,**
Auburn Univ., AL. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2F.
W86-00074

**ONE-DIMENSIONAL ANALYTICAL SOLUTIONS FOR THE MIGRATION OF A THREE-MEMBER RADIONUCLIDE DECAY CHAIN IN A MULTILAYERED GEOLOGIC MEDIUM,**
Battelle Project Management Div., Columbus, OH. Office of Nuclear Waste Isolation.
A. B. Gureghian, and G. Jansen.
Water Resources Research, Vol. 21, No. 5, p 733-742, May, 1985. 9 Fig, 3 Tab, 13 Ref, 2 Append.

Descriptors: *Path of pollutants, *Groundwater pollution, *Radioactive wastes, Transport, Waste disposal, Radionuclides, Laplace equation, Computers.

The Laplace transform method was used to analytically solve the one-dimensional transport equation of a three-member decay chain in a stratified geologic medium. The solution for the nondispersive case is exact. The solution for the general case, although analytic in the first layer, takes a semianalytical form in the subsequent layers by virtue of its numerical integration requirements. Two types of boundary conditions are considered at the source, i.e., a continuous and a band release mode. The accuracy of the solutions was satisfactorily tested on a selected number of problems for which experimental and analytical solutions were available. The practical use of the solutions in a two-dimensional domain is illustrated by a scenario of radionuclide migration from a high level waste repository located in a saturated multilayered aquifer. The computational scheme was programmed in FORTRAN IV and executed on a CDC/CYBER-74-NOS-BE operating system. (Baker-IVI)
W86-00081

**SEDIMENT-WATER INTERFACE IN MODELING PESTICIDES IN SEDIMENTATION PONDS,**
Princeton Univ., NJ. Dept. of Civil Engineering.
P. R. Jaffe, and R. A. Ferrara.
In: Proceedings of Stormwater and Water Quality Model User Group Meeting, January 27-28, 1983, University of Florida, Gainesville. p 53-64, 6 Fig, 1 Tab, 4 Ref.

Descriptors: *Model studies, *Bottom sediments, *Sedimentation, *Pesticide kinetics, *Sediment transport, *Adsorption, *Fate of pollutants, *Sedimentation basins, Settling basins, Pesticides, Models, Simulation analysis, Partition coefficient, Particulate matter, Path of pollutants.

A model was developed to study what effect a sedimentation pond may have on the pesticide load carried via sediment transport to receiving waters. The water column of the pond is represented as a completely mixed system. To model this system, equations are required to describe the changes in volume, suspended sediments, adsorbed pesticide concentration, dissolved pesticide concentration, and pesticide concentration in the bottom sediments. Results of several simulations showed that the peak concentration of pesticides in the sedimentation pond is about 3% of the peak storm runoff concentration without a pond. If the partition coefficient is increased, the reduction of the peak concentration is even higher, indicating the improved removal efficiency of the sedimentation process. If no decay occurs, the total yearly load to the receiving waters will be the same with or without a pond once final conditions occur (after a few seasons). If some decay occurs, the total yearly load at final conditions will be less with a pond than without one.
W86-00088

**MIXING ZONE MODEL FOR CONSERVATIVE PARAMETERS,**
Oklahoma Water Resources Board, Oklahoma City.
For primary bibliographic entry see Field 5G.
W86-00089

**SOME RECENT ADAPTATIONS AND APPLICATIONS OF QUAL-II IN THE NORTHEAST,**
W. W. Walker.
In: Proceedings of Stormwater and Water Quality Model User Group Meeting, January 27-28, 1983, University of Florida, Gainesville. p 87-101, 5 Fig, 1 Tab, 22 Ref.

Descriptors: *Computer models, Models, *Model studies, *Water quality, *Dissolved oxygen, *Nitrogen, *Phosphorus, *Nutrients, Waste load, Rivers, River basins, Simulation analysis, Phytoplankton, Ammonia, Algae.

The modifications of the QUAL-II model to improve simulations of dissolved oxygen conditions in rivers heavily impacted by photosynthesis are discussed along with recent applications of the model in New England. To improve simulations of phytoplankton, nutrients, and oxygen compartments were added for detrital organic P and organic N, algal uptake of ammonia and/or nitrate N, self-shading by phytoplankton, and specification of alternative nutrient limitation by N or P. The Vermont Agency of Environmental Conservation used the QUAL-II model during a wasteload allocation study on the Winooski River when assessing the possible requirements for advanced waste treatment. The Sebasticook River study examined the impacts of a combined municipal/industrial discharge on a small stream (upper east branch) which discharges into an inlet of Lake Sebasticook, a eutrophic Maine lake. The model was also applied to the Sudbury/Concord Rivers in Massachusetts as part of an assessment of the potential environmental constraints involved in diverting waters from the upper watershed for water supply purposes. Interfacing the model output with SAS and plotting routines facilitates calibration, testing, and statistical analysis of observed and predicted water quality profiles. The revised code can be used on microcomputers or mainframes with FORTRAN capability.
W86-00090

**REVIEW OF MODEL USE IN EVALUATING NONPOINT SOURCE LOADS FROM FOREST MANAGEMENT ACTIVITIES,**
National Council of the Paper Industry for Air and Stream Improvement Inc., New York.
G. G. Ice, and R. C. Whittemore.
In: Proceedings of Stormwater and Water Quality Model User Group Meeting, January 27-28, 1983, University of Florida, Gainesville. p 102-122, 6 Fig, 7 Tab, 24 Ref.

Descriptors: *Forest management, *Forest watersheds, Sediments, Erosion, *Nonpoint pollution sources, *Model studies, *Hydrologic models, *Water quality management, *Channel erosion, Water quality, *Soil erosion, Erosion, Landslides, Models, Prediction, Stream degradation.

There is currently an urgent need to validate models that predict water quality, streambed, and stream biota responses to forest practices due to the Clean Water Act and the diverse silvicultural nonpoint source (NPS) control programs developed under Section 208. In addition to regulatory requirements for the use of models, the forestry community has recently begun to consider the consequences of multiple forest operations on water quality. Models are needed to predict not only changes in sediment concentration (the traditional NPS measure for forest practice impacts on water quality) but also changes in channel conditions and the beneficial uses of the water. In response to these demands, the EPA published 'An approach to Water Resources Evaluation of Nonpoint Silvicultural Sources' (WRENSS) in 1980. The sediment prediction components of WRENS include models for water quantity, surface erosion, landslides, and total potential sediment and channel modification. The National Council for Air and Stream Improvement (NCASI) has used WRENSS to predict baseline sediment yields from undisturbed basins. NCASI is collecting data from landslide surveys to evaluate predictive methods. The Siuslaw National Forest procedures predict a number of forest-wide responses to various stresses. The areas where model development are needed are identified along with research programs that would enhance understanding of forest water quality modeling.
W86-00091

**MECHANISTIC SIMULATION FOR TRANSPORT OF NONPOINT SOURCE POLLUTANTS,**
Simons, Li and Associates, Inc., Fort Collins, CO.
D. B. Simons, R.-M. Li, and K. G. Eggert.
In: Proceedings of Stormwater and Water Quality Model User Group Meeting, January 27-28, 1983, University of Florida, Gainesville. p 146-160, 5 Fig, 13 Ref.

Descriptors: *Model studies, *Watershed management, *Erosion, *Simulation analysis, *Nonpoint pollution sources, *Fate of pollutants, *Path of pollutants, Watersheds, Nutrients, Organic matter, Dissolved solids, Pesticides, Sediments, Stream degradation, Bank erosion, Channel erosion.

A simulation model for evaluation of alternative management parameters is presented. The model may be used to predict watershed response to land use, including both planned and unplanned events. Nonpoint source pollution from these events may include loading of streams by sediment from erosion, thermal energy, biological contaminants, organic debris, nutrients and dissolved solids, pesticides, and other wastes in solution or adsorbed to sediments. The simulation consists of a soil-plant-atmospheric water simulation for adjusting soil moisture as a function of evaporation, evapotranspiration, soil water hydraulics, and snowmelt, and a kinematic wave surface water routing component. Other model compartments predict hydraulically-based sediment yield, subsurface flow, temperature and dissolved oxygen, pollutant routing and streambank erosion and forest litter routing. This preliminary planning model should be useful in evaluating selected alternatives as a function of environmental goals.
W86-00092

**ASSESSMENT OF HEAVY METALS AND PCB'S AT SELECTED SLUDGE APPLICATION SITES IN ONTARIO,**
Department of the Environment, Ottawa (Ontario).
For primary bibliographic entry see Field 5A.
W86-00102

**NUTRIENT INPUT FROM THE LOXAHATCHEE RIVER ENVIRONMENTAL CONTROL DISTRICT SEWAGE-TREATMENT PLANT TO THE LOXAHATCHEE RIVER ESTUARY, SOUTHEASTERN FLORIDA,**
Geological Survey, Tallahassee, FL. Water Resources Div.
W. H. Sonntag, and B. F. McPherson.
Available from the OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigation Report 84-4020, 1984. 23 p, 3 Fig, 8 Tab, 4 Ref.

Descriptors: *Effluents, *Nutrients, Water quality, Loxahatchee River estuary, *Florida, *Estuaries, *Sewage effluents.

Two test discharges of treated-sewage effluent were made to the Loxahatchee River in February and September 1981 from the ENCON sewage-treatment plant to document nutrient loading and downstream transport of the effluent to the estuary under maximum daily discharge allowable by law (4 million gallons per day). Concentrations of total nitrogen in the effluent exceeded background concentrations by as much as 7 times during the February test, while concentrations of total phosphorus exceeded background concentrations by as much as 112 times during the September test. The effluent was transported downstream to the estuary in less than 24 hours. Discharge of treated sewage effluent to the river-estuary system in the 1981 water year accounted for less than 0.5 percent of the total nitrogen and 8 percent of the total phosphorus discharged from the major tributaries to the estuary. If maximum discharges of effluent (4 million gallons per day) were sustained throughout the year, annual nitrogen loading from the effluent would account for 5 to 18 percent of the total nitrogen input by the major tributaries to the estuary. With maximum discharges of effluent, annual phosphorus loading would exceed the amount of phosphorus input by the major tributaries to the estuary by 54 to 167 percent. (USGS)
W86-00110

**ASSESSMENT OF WATER RESOURCES IN LEAD-ZINC MINED AREAS IN CHEROKEE COUNTY, KANSAS, AND ADJACENT AREAS,**
Geological Survey, Lawrence, KS. Water Resources Div.
For primary bibliographic entry see Field 5A.
W86-00121

**DIGITAL SIMULATION OF THE REGIONAL EFFECTS OF SUBSURFACE INJECTION OF LIQUID WASTE NEAR PENSACOLA, FLORIDA,**
Geological Survey, Tallahassee, FL. Water Resources Div.
M. L. Merritt.
Available from the OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigation Report 84-4042, 1984. 73 p, 19 Fig, 1 Tab, 30 Ref.

Descriptors: *Liquid wastes, *Injection, *Waste disposal, *Water pollution effects, *Hydraulic models, *Computer models, *Florida, Water pollution sources, Injection effects, Floridan aquifer.

Industrial, organic, liquid waste has been injected into a part of the lower limestone of the Floridan aquifer at one site since 1963 and at another site since 1975, raising water levels in the injection zone throughout a large region. The hydrogeologic conceptual model of the injection zone is a layer tightly confined above by a thick layer of clay and in which lateral hydraulic conductivity decreases rapidly below the upper 60 feet. Recharge areas are to the north and east, where the confining layer pinches out. There appear to be permeability barriers to the northwest, west, and southwest due to facies changes, faults, or pinchouts. Measured and reconstructed preinjection water levels suggested that flow in the aquifer is from the northern recharge areas toward the southeast. A steady-state model simulation incorporating the cited boundary assumptions approximately simulated this pattern. A two-dimensional flow model and the subsurface waste injection program (SWIP) were calibrated to simulate the water level increases at various monitor wells since 1963. Sensitivity analyses showed the simulations to be quite sensitive to moderate errors in either transmissivity or storage parameter specifications. The predictive use of the hydraulic model is understood to be restricted to the geographical locations of data used for model calibration. (USGS)
W86-00122

**TREND ANALYSIS OF SALT LOAD AND EVALUATION OF THE FREQUENCY OF WATER-QUALITY MEASUREMENTS FOR THE GUNNISON, THE COLORADO, AND THE DOLORES RIVERS IN COLORADO AND UTAH,**
Geological Survey, Lakewood, CO. Water Resources Div.
J. E. Kircher, R. S. Dinicola, and R. F. Middelburg.
Available from the OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigation Report 84-4048, 1984. 69 p, 20 Fig, 15 Tab, 16 Ref.

Descriptors: *Statistical methods, *Regression analysis, Network design, *Water-quality data, *Salinity, *Colorado, *Utah, Colorado River basin, *Trend analysis.

Monthly values were computed for water-quality constituents at four streamflow gaging stations in the Upper Colorado River basin for the determination of trends. Seasonal regression and seasonal Kendall trend analysis techniques were applied to two monthly data sets at each station site for four different time periods. A recently developed method for determining optimal water-discharge data-collection frequency was also applied to the monthly water-quality data. Trend analysis results varied with each monthly load computational method, period of record, and trend detection model used. No conclusions could be reached regarding which computational method was best to use in trend analysis. Time-period selection for analysis was found to be important with regard to intended use of the results. Seasonal Kendall procedures were found to be applicable to most data sets. Seasonal regression models were more difficult to apply and were sometimes of questionable validity; however, those results were more informative than seasonal Kendall results. The best model to use depends upon the characteristics of the data and the amount of trend information needed. The measurement-frequency optimization method had potential for application to water-quality data, but refinements are needed. (USGS)
W86-00123

**PRELIMINARY APPRAISAL OF SEDIMENT SOURCES AND TRANSPORT IN KINGS BAY AND VICINITY, GEORGIA AND FLORIDA,**
Geological Survey, Doraville, GA. Water Resources Div.
For primary bibliographic entry see Field 2J.
W86-00125

**RUNOFF, SEDIMENT TRANSPORT, AND WATER QUALITY IN A NORTHERN ILLINOIS AGRICULTURAL WATERSHED BEFORE URBAN DEVELOPMENT, 1979-81,**
Geological Survey, Urbana, IL. Water Resources Div.
For primary bibliographic entry see Field 2J.
W86-00133

**COEFFICIENTS FOR USE IN THE U.S. ARMY CORPS OF ENGINEERS RESERVOIR MODEL, CE-QUAL-R1,**
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
C. D. Collins, and J. H. Wlosinski.
Technical Report E-83-15, October 1983. Final Report. 120 p, 39 Tab, 357 Ref.

Descriptors: *Data collections, *CE-QUAL-R1, *Computer programs, Algorithms, Reservoirs, Water quality, Respiration, Mortality, Decomposition.

This report supplies information about, and literature values for, many of the coefficients needed for the U.S. Army Corps of Engineers Reservoir Model, CE-QUAL-R1. Most of the information presented concerns biological processes of gross production, ingestion, respiration, mortality, and decomposition. Coefficients specified are suitable for the algorithms described in the Instruction Report E-82-1 entitled CE-QUAL-R1: A Numerical One-Dimensional Model of Reservoir Water Quality: User's Manual,' available from the Environmental Laboratory, U.S. Army Engineer Waterways Experiment Station, CE, Vicksburg, Miss. (Author)
W86-00153

**EFFECTS OF ACID RAIN ON SOIL AND WATER,**
Connecticut Agricultural Experiment Station, New Haven.
For primary bibliographic entry see Field 2K.
W86-00166

**POINT SOURCES-NONPOINT SOURCES TRADING IN THE LAKE DILLON WATERSHED,**
Northwest Colorado Council of Governments, Frisco.
Final Report, 1984. 45 p.

Descriptors: *Nonpoint pollution sources, *Point pollution sources, *Trading, *Algae growth, *Advanced wastewater treatment, *Water pollution sources, Phosphorus, Eutrophication, Lake Dillon.

Lake Dillon is a highly valued water supply and recreational resource in north-central Colorado. Changing land uses and development in the basin have produced near-eutrophic algae growth in the lake. All wastewater treatment plants currently employ advanced wastewater treatment for phosphorus removal. Even with zero phosphorus discharge from treatment plants in the future, nonpoint phosphorus sources from growth areas would make the lake eutrophic. A phosphorus control plan for the lake was developed by local governments and adopted by the Colorado Water Quality Control Commission. The plan recommended that advanced wastewater treatment continue to be applied to all point sources. State-of-the-art nonpoint sources controls will be applied by local governments to all new development projects in the basin. An effluent trading system was developed to allow point sources growth beyond 1990. The trading system authorized by the State Commission allows dischargers to receive credit for cleaning up nonpoint sources which existed prior to 1984. A 2:1 ratio is used to account for uncertainties in the process. One pound of credit is assigned for each two pounds of preexisting nonpoint source phosphorus which is eliminated. This approach should keep phosphorus loading at 1982 levels. It allows local governments to control phosphorus in the most cost-effective manner without being limited only to further reductions on point sources. (Author)
W86-00167

**FATE OF CHEMICALLY DISPERSED OIL IN THE SEA: A REPORT ON TWO FIELD EXPERIMENTS,**
New Jersey Dept. of Environmental Protection, Trenton.
D. R. Green, J. Buckley, and B. Humphrey.
EPS 4-EC-82-5, December 1982. Environmental Protection Service, Ottawa (Ontario). 125 p, 42 Fig, 16 Tab, 8 Plates, 10 Ref.

Descriptors: *Oil Slicks, *Dispersants, Seawater, Oil Spills, Corexit 9527, Biodegradation.

Three liters of oil were spilled in each of two moored plastic enclosures (CEPEX enclosures) in Saanich Inlet, British Columbia. Corexit 9527 was used to disperse a portion of the surface slick in one enclosure while the other enclosure served as a control. The oil dispersion was stable during the two week period. The average droplet size was 1 micrometer or less. The dispersion of the oil resulted in a rate of biodegradation that is at least an order of magnitude higher than that for undispersed oil. Within 15 days, microbial oxidation of the alkane component of the oil was completed. Only 0.1% of the dispersed oil reached the sediments during the 15 day time period, and this oil was in an advanced state of bacterial decomposition. Loss of volatile components from dispersed oil was slower than from the surface slick. No detectable photochemical oxidation of the dispersed oil or the surface slick occurred during the experiment. Three experimental oil spills of 200, 400, and 200 liters were conducted in October 1978 at Royal Roads, British Columbia. The surface slicks were restrained with a Bennett inshore oil boom. The spilled oil was dispersed using Corexit 9527. The highest recorded concentration of dis-

persed oil was 1 ppm. After 30 min concentrations of 0.05 ppm were normal, decreasing to background within 5 hr. The dispersed oil did not mix deeper into the water column with time. The integrated quality of oil in the water column decreased more rapidly than either the mean oil concentration of the cloud or the maximum concentration. (Author's abstract, modified).
W86-00172

**CHARACTERIZATION OF AEROBIC CHEMICAL PROCESSES IN RESERVOIRS: PROBLEM DESCRIPTION AND MODEL FORMULATION,**
Camp, Dresser and McKee, Inc., Annandale, VA.
R. L. Chen, D. Gunnison, and J. M. Brannon.
Technical Report E-83-16, October 1983. Final Report. 87 p, 21 Fig, 9 Tab, 144 Ref.

Descriptors: *Mathematical models, *Dissolved oxygen, *Hydrologic models, *Rate models, Water quality control, Reservoirs, Stratification, Oxidation process, Aerobic conditions, Anaerobic conditions.

This report discusses oxidation pathways of chemicals and important environmental parameters that affect the transformation rate of selected nutrients and metals in lakes and reservoirs, and presents a model for predicting the transition from anaerobic to aerobic conditions. In order to better demonstrate the necessary components for an aerobic predictive model, consideration was given to the basic concepts of the most commonly available equilibrium models for predicting water quality in lakes. Evaluation of the practicality of available models revealed that, although equilibrium models provide the flexible and comprehensive approaches necessary for water quality prediction, rate models are more precise and reliable in their depiction of the transition from anoxic to aerobic conditions in reservoirs. Oxidation rates of selected nutrients and metals in U.S. Army Corps of Engineers reservoirs were determined in environmentally controlled laboratory investigations. Field measurements of the fate of reduced iron and manganese in the anoxic bottom water of Eau Galle Reservoir, Wisconsin, during destratification, corroborated the laboratory results. These oxidation rate coefficients will form the basic input variables for RE-AERS, a reaeration subroutine of the water quality evaluation model CE-QUAL-R1.
W86-00176

**COMPUTER MODELING OF HYDRODYNAMICS AND SOLUTE TRANSPORT IN CANALS AND MARINAS: LITERATURE REVIEW AND GUIDELINES FOR FUTURE DEVELOPMENT,**
National Board of Waters, Helsinki (Finland).
R. Walton.
Miscellaneous Paper EL-83-5, September 1983. Final Report. U.S. Army Environmental Impact Research Program, Army Engineer Waterways Experiment Station, Vicksburg, MS. 94 p, 45 Fig, 108 Ref.

Descriptors: *Canals, *Marinas, *Hydrodynamics, *Computer models, *Solute transport, Mathematical models, Literature review, Design criteria, Water quality, Physical properties, Model studies, Permits.

A literature review of modeling the hydrodynamics and solute transport processes in tidal canals and marinas is presented. Tidal prism analysis and one- and multi-dimensional models are described. By considering the three areas of physical processes, modeling, and design criteria, it is concluded that much still needs to be learned to enable the engineer to design such systems to meet a rational set of design criteria. In evaluating such proposed designs, the permitting agencies are in the same relative state of uncertainty as to what constitutes a 'good, environmentally acceptable' design. Future direction should include the selection of several varied existing canal and marina sites, and a program to study them to understand the fundamental physics and water quality processes involved. The next step should be to use this information to develop numerical models that can model the important processes observed, and a validation of their formulation. These models should be developed as engineering, as well as scientific, tools to allow easy use by practicing design engineers. A program of selective model and measurement sensitivity should be performed. These criteria should make sense to both the design engineer and the permitting agencies.
W86-00179

**DISSOLVED METHANE CONCENTRATIONS IN THE SOUTHEAST BERING SEA, 1980 AND 1981,**
Science and Education Administration, Fort Lauderdale, FL. Aquatic Plant Management Lab.
For primary bibliographic entry see Field 2K.
W86-00180

**SORPTION BEHAVIOUR OF 14C IN GROUNDWATER/ROCK AND IN GROUNDWATER/CONCRETE ENVIRONMENTS,**
Seakem Oceanography Ltd., Sidney (British Columbia).
B. Allard, B. Torstenfelt, and K. Andersson.
Report Prav 4.27, March 1981. 11 p, 2 Fig, 3 Tab, 18 Ref.

Descriptors: *Fate of pollutants, *Water pollution prevention, *Radioactive wastes, *Carbon radioisotopes, *Sorption, Waste disposal, Underground waste disposal, Calcite, Concrete, Groundwater, Carbonates, Chemical precipitation, Moraine, Montmorillonite, Bentonite, Quartz, Granite, Rocks.

The sorption of carbon-14, present in radioactive waste from powerplants and nuclear fuel waste treatment, was studied in batch and column experiments on several solids. Although sorption of C14 was generally low, it increased with increasing calcium content of the solid. The order of increasing sorption on the solids was as follows: granite, sodium montmorillonite, sandy moraine $<$ clayish moraine $<$ bentonite/quartz (10/90) $<$ calcite $<$ concrete, cement paste. Calcite and sandy moraine were the only materials permeable enough for column tests. In experiments with calcite, the retention factor was 3 (C14 transport was up to 3 times slower than water). Higher retention is expected at lower groundwater flow due to the slow kinetics of sorption on calcite. It is expected that the retention factor for concrete and bentonite/quartz would be high enough for use as backfill materials in a radioactive waste repository. No C14 would leak from intact concrete. Even fractured concrete would retain most of the C14 by precipitation of carbonate.
W86-00184

**USER GUIDE FOR LARM2: A LONGITUDINAL-VERTICAL, TIME-VARYING HYDRODYNAMIC RESERVOIR MODEL,**
Edinger (J.E.) Associates, Inc., Wayne, PA.
E. M. Buchak, and J. E. Edinger.
Instruction Report E-82-3, December 1982. Final Report. U.S. Army Environmental and Water Quality Operational Studies, Army Engineer Waterways Experiment Station, Vicksburg, MS. 91 p, 4 Fig, 4 Ref, 9 Append. Contract/Grant No. DACW39-78-C-0057.

Descriptors: *Fate of pollutants, *Lakes, *Reservoirs, *Water quality, *Model studies, Mathematical models, LARM2 model, Computer models, Hydrodynamics, Dillon Reservoir, Colorado.

LARM2 (laterally averaged reservoir model, version 2) has several improvements over the parent model, LARM. It incorporates a water quality transport module (WQTM) and the capability to add or delete upstream longitudinal segments during flooding or drawdown. This user's guide contains an overview of the model, a summary of its theoretical basis, a description of its application procedure, and an example, the Dillon Reservoir, Colorado. The appendixes include an input data description with examples and user notes for two auxiliary codes. LARM2 can be applied to a single, continuous reach of a river, lake, or reservoir. For $300 computer time, this model can be used for an eight-month simulation at a time step of 15 min for temperature and one other constituent on a grid that is 30 segments by 20 layers with 375 active cells. Estimates do not include intermediate simulations and postprocessing of results.
W86-00190

**HYDROCARBONS ASSOCIATED WITH SUSPENDED MATTER IN THE GREEN RIVER, WASHINGTON,**
National Oceanic and Atmospheric Administration, Seattle, WA. Pacific Marine Environmental Lab.
S. E. Hamilton, and J. D. Cline.
NOAA Technical Memorandum ERL PMEL-30, May 1981. 116 p, 20 Fig, 18 Tab, 1 Ill, 62 Ref, 3 Append.

Descriptors: *Fate of pollutants, *Hydrocarbons, *Rivers, *Suspended solids, *Wastewater treatment, Effluents, Green-Duwamish River, Washington, Aromatic hydrocarbons, Aliphatic hydrocarbons, Vegetation, Outfall, Wastewater outfall, Sediments, Organic compounds.

The suspended hydrocarbon composition in the Green-Duwamish River was defined seasonally and spatially, with special interest in the discharges from the Renton Secondary Treatment Plant. Above Auburn, Washington, the hydrocarbon mixture is dominated by odd-carbon paraffins derived from aquatic and terrestrial plants. In December the C15 and C17 alkanes associated with algae were at the lowest levels of the year. At the sewage outfall the proportion of odd- to even-carbon hydrocarbons decreased, reflecting the increase in even-carbon n-alkanes, pristane, and phytane. Concentrations of total alphatics, total aromatics, and an unresolved complex mixture increased with distance downriver. A hydrocarbon budget calculated for the lower river showed that heavy hydrocarbons were preferentially lost below the sewage outfall. Possible causes for this are (1) flocculation or desorption of suspended hydrocarbons as the effluent mixed with the river water and (2) incomplete recovery of material during analysis. Suspended matter in the river water contained these aromatics: retene, benz(e)pyrene, perylene, benz(g,h,i)perylene, chrysene, and fluoranthene at concentrations of 0.08-2.2 micrograms per gram dry weight. Levels of perylene and benz(g,h,i)perylene in the effluent were about 40 micrograms per gram. Esters of the even-carbon fatty acids associated with wastewater and higher plants were also found in these sediment samples.
W86-00196

**WORKING PAPERS PREPARED AS BACKGROUND FOR TESTING FOR EFFECTS OF CHEMICALS ON ECOSYSTEMS.**
National Research Council, Washington, DC. Committee to Review Methods for Ecotoxicology.
For primary bibliographic entry see Field 5C.
W86-00230

**ECOTOXICOLOGY AT THE WATERSHED LEVEL,**
Pacific Northwest Forest and Range Experiment Station, Corvallis, OR. Forestry Sciences Lab.
L. A. Norris.
In: Working Papers Prepared as Background for Testing for Effects of Chemicals on Ecosystems, National Academy Press, Washington, DC. 1981. p 137-148, 9 Ref.

Descriptors: *Ecotoxicology, *Fate of pollutants, *Water pollution effects, *Organic compounds, *Aquatic habitats, Lakes, *Ecosystems, *Toxicology, Watersheds, *Environmental effects, Chemical properties, Heavy metals, Metals, Solubility, Vapor pressure, Stability.

Relatively few toxicological tests on the watershed (ecosystem) level have been done. Traditional techniques emphasize direct effects of chemicals on selected organisms. However, indirect effects are also important and may be far-reaching on the ecosystem level. For example, a chemical which reduces the primary productivity of an ecosystem may not directly affect organisms on higher troph-

ic levels, but the reduction in primary production may have an overwhelming effect. Other factors such as logging or tilling may interact with the chemicals of interest. Baseline values are necessary to determine the effects of natural processes such as carbon fixation by primary producers, energy transfers, nutrient cycling, and decomposition or organic substrates. Watershed pairing is desirable, but few are available for this purpose. Many factors affect the behavior of chemicals in the environment: properties of the chemical (water solubility, equilibrium vapor pressure, partition coefficient, and pH); and environmental properties (climatic, edaphic, topographic, and biotic). Chemicals of particular concern are heavy metals and substances with low water and high fat solubility, high equilibrium vapor pressure, high degree of stability, and high degree of mobility in soil.
W86-00234

**UTILITY OF SINGLE SPECIES AND ECOSYSTEM TESTS IN ASSESSING THE ENVIRONMENTAL IMPACT OF RADIONUCLIDE ECOTOXICANTS,**
Emory Univ., Atlanta, GA. Dept. of Biology.
H. L. Ragsdale.
In: Working Papers Prepared as Background for Testing for Effects of Chemicals on Ecosystems, National Academy Press, Washington, DC. 1981. p 149-173, 61 Ref.

Descriptors: *Ecotoxicology, *Fate of pollutants, *Water pollution effects, *Radioactive wastes, *Aquatic habitats, *Ecosystems, *Aquatic life, *Environmental effects, *Toxicology, Single species tests, Radioisotopes, Microenvironment.

Single species or microcosm tests have a useful, but limited, role in defining radionuclear impacts on organisms. Some of the uses of single species testing include explaining phenomena observed at the ecosystem level, providing preliminary trials prior to large-scale ecosystem testing, studying in greater detail the specific mechanisms identified from ecosystem testing, developing a baseline of potential impact, developing predictive relationships between dose and response, and analyzing damage mechanisms. Ecosystem testing, however, provides comprehensive and conclusive knowledge of radionuclear ecotoxicant impacts which allows analysis of short-term and long-term impacts, provides data whose transferability to other systems and regions can be evaluated, allows extrapolation with maximum confidence, and allows explicit comparison of the severity of impact from a variety of ecotoxicants.
W86-00235

**ECOSYSTEM APPROACH TO THE TOXICOLOGY OF RESIDUE FORMING XENOBIOTIC ORGANIC SUBSTANCES IN THE GREAT LAKES,**
Environmental Research Lab.-Duluth, Grosse Ile, MI. Large Lakes Research Station.
W. R. Swain.
In: Working Papers Prepared as Background for Testing for Effects of Chemicals on Ecosystems, National Academy Press, Washington, DC. 1981. p 193-257, 2 Fig, 18 Tab, 129 Ref.

Descriptors: *Fate of pollutants, *Water pollution effects, *Great Lakes, *Toxicology, *Ecosystems, *Aquatic habitats, *Pesticides, *Organochlorine pesticides, Insecticides, *Chlorinated hydrocarbons, Lakes, DDT, Polychlorinated biphenyls, Dieldrin, Lindane, Methoxychlor, Endosulfan, Benzene hexachloride, Plankton, Sediments, Lake sediments, Aldrin, Endrin, Heptachlor, Chlordane, Phthalates, Fish, Public health, Food chains.

A conceptual framework is presented for an ecosystem approach to the question of the impact of residue forming toxic substances of anthropogenic origin in the Great Lakes. This framework is an attempt to link a definite and orderly progression of events related to input sources of toxic substances and their compartmentalization phenomena. It is believed to be of utility because it considers interrelationships and properties between separate entities, incorporates defined criteria, and utilizes a series of linkages into which quantifiable values and numerically precise data can be inserted to enable an adequate mechanism for understanding the fate, transport and effects of toxic organochlorine compounds. Given the magnitude of the Great Lakes ecosystem in both spatial and temporal scales, the interdependency of the various ecosystem compartments and the multiplicity of exogenous substances with differing chemical/biological reactions, it is difficult to conceive that any other approach to the question could adequately address the complexity of the issue. While short term laboratory tests are useful in delineating areas of the environment where problems can be anticipated, often the question of scale makes direct translation of results to the Great Lakes difficult, if not impossible. The approach described in this effort is an attempt to overcome these difficulties for toxic xenobiotic organochlorine compounds. (Author)
W86-00237

**LEACHATE FROM HAZARDOUS WASTES SITES,**
New Jersey Inst. of Tech., Newark. Dept. of Civil and Environmental Engineering.
P. N. Cheremisinoff, and K. A. Gigliello.
Technomic Publishing Co., Inc., Lancaster, PA. 1983. 88 p.

Descriptors: *Water pollution sources, *Fate of pollutants, *Leachates, *Landfills, *Water disposal, Solid waste disposal, Sampling, Monitoring, Wells, Model studies, Pollutant identification, Linings, Plastics, Water pollution control, Wastewater treatment, Water pollution effects, Groundwater pollution, Damage.

This report is a guide to the formation, generation, sampling methodology, control, and treatment of leachate from solid waste sites. Four types of disposal sites are defined--dump, landfill, sanitary landfill, and secured landfill. The mechanisms for contamination of groundwater by leachates are described. The processes of infiltration, percolation, evaporation, and transpiration are involved in leachate generation. Leachate characteristics vary from site to site. The volume depends on the soil's absorptive capacity, areal extent, composition, placement, cover material and operation, and amount of recharge water available for infiltration. The water balance method may be used to estimate leachate generation. Sampling considerations and methods are given for seeps, wells, and leachate collection systems. Laboratory methods applicable to leachate assessment include modeling techniques, shake tests, saturation tests, column tests, and field test cells. Effects of leachate on lining materials are summarized. Among leachate control methods are proper selection of waste, control of water movement, control of decay, lining with leachate collection, leachate treatment, natural renovation, incineration, aeration, leachate recycle, and integrated treatment systems. Leachate damage, usually contamination of wells, and case histories are described.
W86-00247

**STREAM WATER QUALITY IN THE COAL REGION OF ALABAMA AND GEORGIA,**
Northeastern Forest Experiment Station, Broomall, PA.
K. L. Dyer.
Available from the National Technical Information Service, Springfield, VA 22161, as PB83-1246363. General Technical Report NE-73, 1982. 109 p, 34 Fig, 65 Tab, 8 Ref.

Descriptors: *Fate of pollutants, *Water pollution sources, *Water quality, *Streams, *Coal mining, Strip mines, Watersheds, Alabama, Georgia, Appalachia, Small watersheds, Forest watersheds.

Water quality data for 58 small streams in 12 counties of Alabama and 3 in Dade County, Georgia, are given for the period July 19, 1977, to August 10, 1979. Twenty of the watersheds were unmined. Thirty-eight of the watersheds had been surface mined, some recently (after 1972) some mined before 1972. Data included are bicarbonate, carbonate, chloride, sulfate, alkalinity, acidity, pH, specific conductance, 16 trace elements, ammonia, nitrate, nitrate plus nitrite, total nitrogen, phosphorus, orthophosphate, water temperature, suspended solids, turbidity, settleable matter, and estimated discharge. The interpretation of the data will be presented in a later report covering nine states in the Appalachian area.
W86-00250

**STREAM WATER QUALITY IN THE COAL REGION OF WEST VIRGINIA AND MARYLAND,**
Northeastern Forest Experiment Station, Berea, KY.
K. L. Dyer.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-118182. General Technical Report NE-70, 1982. 215 p, 71 Fig, 131 Tab, 8 Ref.

Descriptors: *Fate of pollutants, *Water pollution sources, *Water quality, *Streams, *Coal mining, Strip mines, Watersheds, West Virginia, Maryland, Appalachia, Small watersheds, Forest watersheds.

Water quality data for 118 small streams in 27 counties of West Virginia and nine streams in two counties of western Maryland are given for the period June 9, 1977, to November 9, 1979. Forty-eight of the watersheds were unmined. Seventy-nine of the watersheds had been surface mined, some recently (after 1972) and some mined before 1972. Data included are bicarbonate, carbonate, chloride, sulfate, alkalinity, acidity, pH, specific conductance, 16 trace elements, ammonia, nitrate, nitrate plus nitrite, total nitrogen, phosphorus, orthophosphate, water temperature, suspended solids, turbidity, settleable matter, and estimated discharge. The interpretation of the data will be presented in a later report covering nine states in the Appalachian area.
W86-00253

**ARCTIC MARINE OILSPILL PROGRAM (AMOP) REMOTE SENSING STUDY,**
Canada Centre for Remote Sensing, Ottawa (Ontario).
For primary bibliographic entry see Field 7B.
W86-00258

**MATHEMATICAL MODEL, SERATRA, FOR SEDIMENT-CONTAMINANT TRANSPORT IN RIVERS AND ITS APPLICATION TO PESTICIDE TRANSPORT IN FOUR MILE AND WOLF CREEKS IN IOWA.**
Battelle Pacific Northwest Labs., Richland, WA.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-122671. EPA 600/3-82-045, August 1982. Environmental Research Laboratory, Athens, GA. 56 p, 24 Fig, 1 Tab, 26 Ref. Contract/Grant No. 68-03-2613.

Descriptors: *Fate of pollutants, *Model studies, *Sediment transport, *Pesticides, *Streams, *Water quality, SERATRA model, Degradation, Biodegradation, Volatility, Hydrolysis, Oxidation, Photolysis, Particulate matter, Finite element method, Four Mile Creek, Wolf Creek, Iowa, Mathematical models, Bottom sediment, Alachlor, Sedimentation.

The sediment-contaminant transport model SERATRA was used as an integral part of the Chemical Migration and Risk Assessment Methodology, which simulates migration and fate of a contaminant over the land surface and in receiving streams, to assess potential short- and long-term impact on aquatic biota. SERATRA, an unsteady, two-dimensional (longitudinal and vertical) finite element model, consists of three submodels coupled to include the effects of sediment-contaminant interactions--a sediment transport submodel, a dissolved contaminant transport submodel, and a particulate contaminant (contaminants adsorbed by sediment) transport submodel. The sediment transport submodel simulates transport, deposition, and scouring of three sediment size fractions of cohesive and noncohesive sediments. The dissolved contaminant transport submodel includes mechanisms of contaminant adsorption/desorption and

contaminant degradation resulting from hydrolysis, oxidation, photolysis, volatilization, biological activities and radionuclide decay to predict migration of dissolved contaminant. The particulate contaminant submodel simulates transport, deposition and scouring of contaminants associated with three size fractions of sediments. SERATRA also predicts changes of bed conditions for sediment and particulate contaminants. (Author)
W86-00259

**PLANNING GUIDE FOR EVALUATING AGRICULTURAL NONPOINT SOURCE WATER QUALITY CONTROLS,**
Cornell Univ., Ithaca, NY.
For primary bibliographic entry see Field 5G.
W86-00260

**STREAM WATER QUALITY IN THE COAL REGION OF OHIO,**
Northeastern Forest Experiment Station, Broomall, PA.
K. L. Dyer.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-119495. General Technical Report NE-75, 1982. 138 p, 46 Fig, 73 Tab, 8 Ref.

Descriptors: *Fate of pollutants, *Water pollution sources, *Water quality, *Streams, *Coal mining, Strip mines, Watersheds, Ohio, Appalachia, Small watersheds, Forest watersheds.

Water quality data for 70 small streams in 19 counties of Ohio are given for the period June 1, 1977, to October 4, 1979. Nineteen of the watersheds were unmined. Fifty of the watersheds had been surface mined, some recently (after 1972) and some mined before 1972. Data included are bicarbonate, carbonate, chloride, sulfate, alkalinity, acidity, pH, specific conductance, 16 trace elements, ammonia, nitrate, nitrate plus nitrite, total nitrogen, phosphorus, orthophosphate, water temperature, suspended solids, turbidity, settleable matter, and estimated discharge. The interpretation of the data will be presented in a later report covering nine states in the Appalachian area.
W86-00267

**STREAM WATER QUALITY IN THE COAL REGION OF PENNSYLVANIA,**
Northeastern Forest Experiment Station, Broomall, PA.
K. L. Dyer.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-124586. General Technical Report NE-76, 1982. 168 p, 61 Fig, 88 Tab, 8 Ref.

Descriptors: *Fate of pollutants, *Water pollution sources, *Water quality, *Streams, *Coal mining, Strip mines, Watersheds, Pennsylvania, Appalachia, Small watersheds, Forest watersheds.

Water quality data for 86 small streams in 23 counties of Pennsylvania are given for the period July 13, 1977, to October 4, 1979. Twenty-nine of the watersheds were unmined. Fifty-seven of the watersheds had been surface mined, some recently (after 1972) and some mined before 1972. Data included are bicarbonate, carbonate, chloride, sulfate, alkalinity, acidity, pH, specific conductance, 16 trace elements, ammonia, nitrate, nitrate plus nitrite, total nitrogen, phosphorus, orthophosphate, water temperature, suspended solids, turbidity, settleable matter, and estimated discharge. The interpretation of the data will be presented in a later report covering nine states in the Appalachian area.
W86-00281

**SURVEY OF POLYCHLORINATED BIPHENYLS IN INDUSTRIAL EFFLUENTS IN CANADA.**
Environmental Protection Service, Ottawa (Ontario). Water Pollution Control Directorate.
Report EPS 3-WP-81-1, March 1981. 19 p, 5 Tab, 26 Ref.

Descriptors: *Water pollution sources, *Fate of pollutants, *Polychlorinated biphenyls, *Organic compounds, *Industrial wastewater, Pulp and paper industry, Aluminum, Paint industry, Chemical industry, Chlorinated hydrocarbons, Canada.

Polychlorinated biphenyls (PCBs) in industrial effluents and process streams in Canada were sampled in two phases: (1) an overall survey involving 308 samples in 31 types of industries and (2) sampling of 45 effluents from 7 selected plants discharging significant quantities of PCBs. Of the 308 samples from general industry, 48 contained more than 0.1 ppb PCB. These industries were pulp and paper, smelting, paint manufacturing, electrical equipment manufacturing, chemicals, sewage treatment, aviation, iron and steel, petrochemicals, mining, poultry packing, waste oil recycling, food products, machine shop, and coal superport. A pulp and paper mill using recycled paper discharged effluents with 28.0-48.2 ppb PCB. Other plants and the PCB concentrations (ppb) of their effluents were aluminum smelting, 0.11-3.94; paint manufacturing, 0.24-4.66; petrochemicals, 0.42; and chemical manufacturing, 5.1. Likely sources of PCB in the effluents were recycled waste paper, hydraulic fluids, paint pigments, and electrical oils. PCBs, probably with 4 or less chlorine atoms per molecule, may be formed inadvertently by some plant processes (chlorination of waste biphenyls in wastewater treatment or synthesis from certain aromatic compounds). However, none were detected in this study, which did not use analytical methods designed to detect lower-chlorine PCBs.
W86-00286

**USE OF SATELLITE IMAGERY FOR TRACKING THE KURDISTAN OIL SPILL,**
Remotec Applications Ltd., St. John's (Newfoundland).
For primary bibliographic entry see Field 7B.
W86-00291

**EFFECTS, PATHWAYS, PROCESSES, AND TRANSFORMATION OF PUGET SOUND CONTAMINANTS OF CONCERN,**
E.V.S. Consultants Ltd., North Vancouver (British Columbia).
D. E. Konasewich, P. M. Chapman, E. Gerencher, G. Vigers, and N. Treloar.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-118208. NOAA Technical Memorandum OMPA-20, July 1982. National Oceanic and Atmospheric Administration, Boulder, CO. 357 p, 35 Fig, 37 Tab, 765 Ref.

Descriptors: *Fate of pollutants, *Water pollution effects, *Estuaries, Sediments, *Toxicity, *Organic compounds, Benthos, *Puget Sound, Chlorinated hydrocarbons, Polyaromatic hydrocarbons, Naphthalene, Benzo(a)anthracene, Fluoranthenes, Benzo(a)pyrene, Arsenic, Cadmium, Heavy metals, DDT, Insecticides, Pesticides, Polychlorinated biphenyls, Hexachlorobenzene, Phthalates, Copper, Lead, Mercury, Selenium, Silver, Aquatic life, Inorganic compounds, Bioaccumulation, Biodegradation, Water pollution sources.

Toxicity and distribution data on the 183 organic compounds and 37 inorganic ions identified in Puget Sound sediments, biota, and waters were reviewed. The chemicals were classified into six categories based on degree of concern for the environment. The 15 contaminants or classes of contaminants of greatest concern were polychlorinated dibenzofurans and chlorophenol precursors, chlorinated butadienes, polyaromatic hydrocarbons and halogenated derivatives, arsenic, cadmium, DDT and metabolites, polychlorinated biphenyls, hexachlorobenzene and related compounds, chlorinated ethylenes, phthalates, copper, lead, mercury, selenium, and silver. The study concluded that concentrations of many contaminants were higher in the Puget Sound ecosystems than in other areas of the world. Four research needs were identified: (1) develop and implement a surveillance plan to assess trends and fate and effects of pollutants (2) develop an ecological hazard assessment scheme, (3) establish the relationship between levels of contaminants in sediments and benthic biota and the consequent toxic effects of these levels on biota, and (4) develop additional basic information on the behavior and fate of chemicals in the marine and estuarine environments.
W86-00293

**EUROPEAN AND UNITED STATES CASE STUDIES IN APPLICATION OF THE CREAMS MODEL.**
International Inst. for Applied Systems Analysis, Laxenburg (Austria).
IIASA Collaborative Proceedings Series CP-82-S11, 1982. Edited by V. Svetlosanov and W. G. Knisel. 148 p.

Descriptors: *Fate of pollutants, *Water pollution sources, *Water quality control, *Model studies, *Hydrology, *Erosion, *Sediment yield, Pesticides, *Nonpoint pollution sources, Agricultural hydrology, Nutrients, Phosphorus, Nitrogen, Agricultural chemicals, Fertilizers, Leaching, *Mathematical models, CREAMS model.

CREAMS (Chemicals, Runoff, and Erosion from Agricultural Management Systems), a mathematical model for determining nonpoint source pollution, has three components: hydrology, erosion/sedimentation, and chemistry (nutrients and pesticides). Part I describes the model and shows how it is applied. Parts II and III concern case studies in several European countries: Finland, Germany, Poland, Sweden, United Kingdom, and Lithuania (USSR). Part IV looks at the future, CREAMS2, which will incorporate the knowledge obtained in this study. Part V summarizes the basic conclusions. Among the conclusions are (1) CREAMS generally gives good representations of the hydrology, erosion/sediment yield, and chemical processes. It needs revision and addition of certain processes (snowmelt, frozen soil, organic fertilizer, etc.) specific to European conditions. CREAMS is useful for evaluating alternate management alternatives but does not predict absolute quantities. CREAMS should be calibrated when data become available. Although it is a field-scale model, it may be a foundation or a component of regional or larger watershed studies. CREAMS2, an improved and more comprehensive model, will also include soil temperature, snowmelt/frozen soil, nitrogen cycling, vertical flux of pesticides, and a totally linked model structure to simplify process interactions and model feedback.
W86-00294

**CREAMS: A SYSTEM FOR EVALUATING MANAGEMENT PRACTICES ON FIELD-SIZE AREAS,**
Agricultural Research Service, Tifton, GA. Southeast Watershed Research Center.
W. G. Knisel, G. R. Foster, M. H. Frere, R. A. Leonard, and A. D. Nicks.
In: European and United States Case Studies in Application of the CREAM Model, IIASA Collaborative Proceedings Series CP-82-S11, 1982. p 7-40, 5 Fig, 4 Tab, 19 Ref.

Descriptors: *Fate of pollutants, *Water pollution sources, *Water quality control, *Model studies, *Hydrology, *Erosion, *Sediment yield, Pesticides, *Nonpoint pollution sources, Agricultural hydrology, Nutrients, Phosphorus, Nitrogen, Agricultural chemicals, *Mathematical models, Fertilizers, Leaching, CREAMS model.

CREAMS (Chemicals, Runoff, and Erosion from Agricultural Management Systems) is a field-scale mathematical model for assessing nonpoint source pollution and evaluating alternate practices for controlling pollution from sediments and chemicals. CREAMS consists of three major components: hydrology, erosion/sedimentation, and chemistry. The hydrology component estimates storm runoff by either of two options, depending on availability of rainfall data: (1) with daily rainfall data and (2) by an infiltration-based method. The erosion component considers the basic processes of soil detachment, transport, and deposition. The chemistry component concerns plant nutrients and pesticides. An example shows the application

of CREAMS to a 3.2-acre field in the Georgia Piedmont area.
W86-00295

TESTING THE APPLICATION OF CREAMS TO FINNISH CONDITIONS,
National Board of Waters, Helsinki (Finland).
L. Kauppi.
In: European and United States Case Studies in Application of the CREAMS Model, IIASA Collaborative Proceedings Series CP-82-S11, 1982. p 43-47, 2 Tab, 3 Ref.

Descriptors: *Fate of pollutants, *Water pollution sources, *Water quality control, *Model studies, *Hydrology, *Erosion, *Sediment yield, Pesticides, *Nonpoint pollution sources, Agricultural hydrology, Nutrients, Phosphorus, Nitrogen, Agricultural chemicals, Fertilizers, Leaching, *Mathematical models, Hovi Basin, *Finland, CREAMS model.

The CREAMS model was applied to the agricultural Hovi basin in Finland. The area under study used the open ditch drainage system. Yearly runoff plus percolation in 1968 was 265 mm (calculated 288 mm) and in 1969 was 223 mm (calculated 229 mm). The daily response lagged by a day because of the ditch system. Soil losses were calculated from the model and from suspended solids concentrations in runoff waters. In 1968 soil loss (in tons per sq km) was 110 (from model) and 14 (from suspended sediments). In 1969 soil loss (in tons per sq km) was 88 (from model) and 24 (from suspended sediments). Nitrogen and phosphorus losses calculated by the model were significantly greater than those calculated from concentrations and runoff observations, particularly in autumn. The model needs modifications to adapt well to Finnish conditions. These considerations include a snowmelt component and further work on calibration and selection of appropriate parameter values.
W86-00296

ENVIRONMENTAL EFFECTS OF NITROGEN FERTILIZATION EXEMPLIFIED BY GROUNDWATER POLLUTION AS SIMULATED BY CREAMS,
Goettingen Univ. (Germany, F.R.).
S. Stemmler.
In: European and United States Case Studies in Application of the CREAMS Model, IIASA Collaborative Proceedings Series CP-82-S11, 1982. p 49-62, 5 Fig, 3 Tab, 16 Ref.

Descriptors: *Fate of pollutants, *Water pollution sources, *Water quality control, *Model studies, *Hydrology, *Erosion, *Nonpoint pollution sources, Agricultural hydrology, Nutrients, Nitrogen, Agricultural chemicals, *Mathematical models, Fertilizers, Nitrates, Mussum water reserve, Germany, Leaching, CREAMS model.

The CREAMS model was tested in the Mussum water reserve area of northwestern Germany. In the hydrology submodel the first runs underestimated percolation (120-180 mm calculated, 300 mm actual) and overestimated evapotranspiration. Changes in the program and equations produced good results in later runs. Nitrate was the only chemical considered in the study. It was possible to quantify the relation between fertilization intensity (up to 480 kg N per ha) of arable land and nitrate concentrations in the water percolated below the root zone. However, results were applicable only to the thin and uniformly distributed aquifers in the study area.
W86-00297

APPLICATION OF THE CREAMS MODEL FOR CALCULATION OF LEACHING OF NITRATE FROM LIGHT SOILS IN THE NOTEC RIVER VALLEY,
Institute for Land Reclamation and Grassland Farming, Raszyn (Poland).
A. Sapek.
In: European and United States Case Studies in Application of the CREAMS Model, IIASA Collaborative Proceedings Series CP-82-S11, 1982. p 63-70, 5 Tab, 1 Ref.

Descriptors: *Fate of pollutants, *Water pollution sources, *Water quality control, *Model studies, *Hydrology, *Nonpoint pollution sources, Agricultural hydrology, Nutrients, Nitrates, Nitrogen, Agricultural chemicals, Fertilizers, Leaching, *Mathematical models, Notec River Valley, Poland, CREAMS model, Denitrification.

The CREAMS model was used for calculation of the amount of leached nitrate below the plant root zone and of the nitrogen balance in light soil with average physical properties occurring in the Notec River valley, Poland. The simulation was performed with the precipitation data for the period 1960-1979. The calculated nitrate leaching averaged about 25 kg N per hectare per year, which constitutes a threat for the water quality and fertilizer economy. Higher nitrogen losses from soil were due to the denitrification process. The largest amounts of nitrate leached and percolation occurred in the autumn-winter months. It seems that the most feasible method of verification of the reliability of model output would be the measurement of the content of nitrate in soil after and before the growing season. (Author)
W86-00298

APPLICATION OF THE CREAMS MODEL: WESTERN SKANE, SWEDEN,
Lund Univ. (Sweden). Dept. of Water Resources Engineering.
L. DeMare.
In: European and United States Case Studies in Application of the CREAMS Model, IIASA Collaborative Proceedings Series CP-82-S11, 1982. p 71-82, 4 Fig, 2 Tab, 11 Ref.

Descriptors: *Fate of pollutants, *Water pollution sources, *Water quality control, *Model studies, *Hydrology, *Nonpoint pollution sources, Agricultural hydrology, Nutrients, Nitrates, Nitrogen, Agricultural chemicals, Fertilizers, Leaching, *Mathematical models, Skane, Sweden, Potatoes, Wheat, CREAMS model.

The hydrology and nutrient components of the CREAMS model were used to evaluate the nitrate leaching from agricultural fields in Skane, at the southern tip of Sweden. Annual leaching amounts corresponded fairly well to results obtained from field experiments. However, CREAMS should not be used to predict absolute quantities. In particular, a small error in estimating percolation in summer causes large errors in leaching output. The model proved useful for comparing nitrate leaching produced from several management practices: potatoes with rain and rain/irrigation; wheat with rain and rain/irrigation.
W86-00299

PREDICTING HILLSLOPE RUNOFF AND EROSION IN THE UNITED KINGDOM: PRELIMINARY TRIALS WITH THE CREAMS MODEL,
National Coll. of Agricultural Engineering, Silsoe (England).
R. P. C. Morgan, and D. D. V. Morgan.
In: European and United States Case Studies in Application of the CREAMS Model, IIASA Collaborative Proceedings Series CP-82-S11, 1982. p 83-97, 4 Tab, 15 Ref.

Descriptors: *Fate of pollutants, *Water pollution sources, *Water quality control, *Model studies, *Hydrology, *Erosion, *Sediment yield, *Nonpoint pollution sources, Agricultural hydrology, *Mathematical models, Silsoe, United Kingdom, Runoff, Slopes, CREAMS model.

Promising results are obtained when the CREAMS model is applied to soil losses in the Silsoe area, United Kingdom. Soil loss predictions are reasonable under these conditions: (1) the concept of channel erosion is extended to include convergences of flow within the overland flow whenever sediment concentrations exceed a critical threshold and (2) observed runoff depths from unbounded plots are calculated with the 1-sq m strategy. The hydrology submodel shows promise as a runoff predictor if the observed runoff is calculated with the 10-sq m strategy. The 10-sq m strategy involves converting the observed runoff volumes to an average depth over 10 sq m; the 1-sq m strategy does the same over a 1-sq m area.
W86-00300

APPLICATION OF THE CREAMS MODEL AS PART OF AN OVERALL SYSTEM FOR OPTIMIZING ENVIRONMENTAL MANAGEMENT IN LITHUANIA, USSR: FIRST EXPERIMENTS,
Lithuanian Research Inst. of Forestry, Vilnius (USSR).
L. Kairiukstis, and G. Golubev.
In: European and United States Case Studies in Application of the CREAMS Model, IIASA Collaborative Proceedings Series CP-82-S11, 1982. p 99-119, 9 Fig, 3 Tab, 5 Ref.

Descriptors: *Fate of pollutants, *Water pollution sources, *Water quality control, *Model studies, *Hydrology, *Erosion, *Sediment yield, *Nonpoint pollution sources, Agricultural hydrology, Nutrients, Phosphorus, Nitrogen, Agricultural chemicals, Fertilizers, Leaching, *Mathematical models, Lithuania, Forests, CREAMS model.

First experiments with the CREAMS model show that it is suitable for predicting hydrology, erosion, and nutrient transport for the conditions in Lithuania. However, it will be necessary to modify the model to compensate for the long, stable snow cover, the high groundwater level, and the processes associated with snowmelt. Although CREAMS was developed for agricultural land, it shows promise for use in forested lands.
W86-00301

REVIEW OF CASE STUDIES OF CREAMS MODEL APPLICATION,
Agricultural Research Service, Tifton, GA. Southeast Watershed Research Center.
W. G. Knisel, and V. Svetlosanov.
In: European and United States Case Studies in Application of the CREAMS Model, IIASA Collaborative Proceedings Series CP-82-S11, 1982. p 123-135, 1 Fig, 2 Tab, 9 Ref.

Descriptors: *Fate of pollutants, *Water pollution sources, *Water quality control, *Model studies, *Hydrology, *Erosion, *Sediment yield, Pesticides, *Nonpoint pollution sources, Agricultural hydrology, Nutrients, Phosphorus, Nitrogen, Agricultural chemicals, Fertilizers, Leaching, *Mathematical models, Czechoslovakia, Germany, Finland, Lithuania, Poland, Sweden, United Kingdom, CREAMS model.

The applicaton of the CREAMS model in these case studies (Czechoslovakia, Germany, Finland, Lithuania, Poland, Sweden, and United Kingdom) have resulted in identification of model limitations and areas which call for improvements. Also, they have shown that CREAMS gives generally good results, and the model is a tool that can be used to aid in development of agricultural management practices for nonpoint source pollution control. Validation with observed data has shown that CREAMS is a suitable model for extrapolating research results to other climatic and soil regions. Although the model gives reasonable results in simulation, it is desirable to calibrate it with data where possible. (Author)
W86-00302

ETHYLENE: ENVIRONMENTAL AND TECHNICAL INFORMATION FOR PROBLEM SPILLS.
Environmental Protection Service, Ottawa (Ontario).
For primary bibliographic entry see Field 5C.
W86-00303

## 5C. Effects Of Pollution

RAPIDITY OF RNA SYNTHESIS IN HUMAN CELLS; A HIGHLY SENSITIVE PARAMETER FOR WATER CYTOTOXICITY EVALUATION,
Service de Controle des Eaux de la Ville de Paris (France).

For primary bibliographic entry see Field 5A.
W86-00052

**WASTEWATER REUSE AND EXPOSURE TO LEGIONELLA ORGANISMS,**
Hadassah Medical School, Jerusalem (Israel). Environmental Health Lab.
B. Fattal, H. Bercovier, M. Derai-Cochin, and H. I. Shuval.
Water Research, Vol. 19, No. 6, p 693-696, 1985. 1 Fig, 2 Tab, 19 Ref.

Descriptors: *Wastewater reuse, *Legionella, *Bacteria, *Public health, Wastewater disposal, Human physiology, Water pollution effects, Fish ponds.

Eight hundred and fifty-two (852) blood sera were drawn in 1980 and 1981 from populations residing in 30 agricultural settlements (having a total population of 16,240). These sera were tested for the presence of antibodies against 15 different antigens of Legionella species (L. pneumophila serogroups 1-8 and seven other Legionella, i.e. bozemanii, gormanii, micdadei, jordanis, dumoffi, longbeacheae and oakridgensis). The results indicate a significant ($P < 0.02$) excess in the percentage of sera positive for L. pneumophila (serogroups 1-8) among sewage and non-sewage irrigation and fish pond workers as compared to the control group (4.5% vs 1.5%). For the other Legionella species, there was no difference among the above groups. The isolation of L. pneumophila serogroup 4 and five organisms resembling Legionella spp from one oxidation pond used for irrigation strengthens the seroepidemiological findings. (Author's abstract)
W86-00054

**PASSAGE OF SELECTED HEAVY METALS FROM SPHAEROTILUS (BACTERIA: CHLAMYDOBACTERIALES) TO PARAMECIUM CAUDATUM (PROTOZOA: CILIATA),**
Middle Tennessee State Univ., Murfreesboro.
M. Mansouri-Aliabadi, and R. E. Sharp.
Water Research, Vol. 19, No. 6, p 697-699, 1985. 2 Tab, 18 Ref.

Descriptors: *Heavy metals, *Sphaerotilus, *Paramecium, *Bacteria, *Bioconcentration, Metals, Protozoa, Bioaccumulation, Zinc, Lead, Manganese, Nickel, Water pollution effects.

The ability of ciliates to purify turbid activated-sludge effluents has been suggested to be the result of predation upon bacteria and flocculation of living and non-living suspended matter. One factor which brings about the absence or reduction in number of ciliated protozoa in activated sludge is the introduction of toxic metals, often as by-products of industrial processes. The possibility that passage of heavy metals occurs from bacteria to protozoa was investigated. Paramecium caudatum protozoans were freed from their associated bacteria and thrived on Sphaerotilus, a bacterium occurring in polluted waters, as their only food source. Sphaerotilus was found to take up Zn, Pb, Ni and Mn; metal-containing cultures of this bacterium were employed to feed P. caudatum, and analytical results revealed the accumulation of Zn, Pb and Ni. The bacteria did not pass Mn to the animals at all even though uptake of Mn by Spaerotilus was relatively high when compared with other metals used in this study. No metals were found in control cultures of paramecia. Since Sphaerotilus was the only food source for paramecia during this study, the results indicate that trace amounts of metals were passed from bacteria to protozoa in a predator-prey relationship. (Collier-IVI)
W86-00055

**HEAVY METAL ACCUMULATION (CD, CU, PB AND ZN) BY SMELT (OSMERUS MORDAX) FROM THE NORTH SHORE OF THE ST LAWRENCE ESTUARY (ACCUMULATION DE QUELQUES METAUX LOURDS (CD, CU, PB ET ZN) CHEZ L'EPERLAN (OSMERUS MORDAX) PRELEVE SUR LA RIVE NORD DE L'ESTUAIRE DU SAINT-LAURENT),**
Quebec Univ., Rimouski. Dept. of Oceanography.
M. Arnac, and C. Lassus.
Water Research, Vol. 19, No. 6, p 725-734, 1985. 4 Fig, 3 Tab, 29 Ref.

Descriptors: *Heavy metals, *Bioaccumulation, *Smelt, *Fish, *St. Lawrence Estuary, *Cadmium, *Copper, *Zinc, *Lead, Metals, Fish physiology, Water pollution effects, Animal tissues, Animal physiology.

A method of physiologically removing metals in marine organisms is by storage in a particular tissue. Several different sites for storing metals were investigated and concentrations of Cd, Cu, Pb and Zn were examined in muscle, liver and gonads of smelt (Osmerus mordax) from the North shore of the St. Lawrence estuary. A modified wet digestion procedure was used to prepare biological samples for the determination of trace elements by flameless atomic absorption spectrophotometry procedure, using calibration standards made up in a matrix of similar acidity. NBS bovine liver reference material was analyzed along with the samples; results were within the specified tolerance. Analyses were reported on a dry weight basis. Copper (range 0.3-3.3 micro-g/g) and zinc (range 19-38 micro-g/g) in muscle fillets were found to be negatively correlated with total body weight. Livers and gonads contained greater levels of the four metals than somatic muscle. Liver metal concentrations of Zn (range 29-108 micro-g/g) and Cd (range 0.06-0.37 micro-g/g) increased with total body weight. All equations fit data at $P < 0.01$. Positive correlations between size and metal concentrations suggest that net uptake may occur. Increasing metal concentrations in liver may represent storage of sequestered products in that organ. In the gonads, no significant relationship exists between total body weight and trace metal contents. Females had significantly greater Cu and Zn concentrations, but no significant difference existed between males and females for Cd concentrations. The relation between concentration and total body weight appears to be specific as to the species, tissues analyzed and environmental conditions. The comparison of metal concentrations in fish to assess variations in contamination levels requires understanding the relationship between metal concentration and body size within each population. (Collier-IVI)
W86-00059

**TOXICITY TO DAPHNIA OF THE END PRODUCTS OF WET OXIDATION OF PHENOL AND SUBSTITUTED PHENOLS,**
Michigan Technological Univ., Houghton. Dept. of Biological Sciences.
For primary bibliographic entry see Field 5D.
W86-00064

**WATER-QUALITY APPRAISAL, MAMMOTH CREEK AND HOT CREEK, MONO COUNTY, CALIFORNIA,**
Geological Survey, Sacramento, CA. Water Resources Div.
For primary bibliographic entry see Field 5A.
W86-00106

**PRELIMINARY EVALUATION OF LAKE SUSCEPTIBILITY TO WATER-QUALITY DEGRADATION BY RECREATIONAL USE, ALPINE LAKES WILDERNESS AREA, WASHINGTON,**
Geological Survey, Seattle, WA. Water Resources Div.
R. J. Gilliom, P. Dethier, S. A. Safioles, and P. L. Heller.
USGS Water-Resources Investigation Open-File Report 80-1124, 1980. 1 p, (map and text), 1 Fig, 1 Tab, 11 Ref.

Descriptors: *Water quality, *Water pollution control, *Recreation planning, *Wilderness lakes, *Land use, Nutrients, Phosphorus, Pathogens, Maps, *Washington, Alpine Lakes Wilderness Area, *Alpine Lakes.

The relative susceptibility of lakes in the Alpine Lakes Wilderness Area to water-quality degradation was evaluated from two perspectives: (1) water-quality sensitivity, which is the tendency of a lake's water quality to degrade in response to pollutant loading, and (2) pollutant-loading likelihood, which is determined by the presence of drainage-basin features that enhance the transport of pollutants to a lake. Water-quality sensitivity was evaluated for 60 lakes, using a mass-balance phosphorus model to predict the response of each lake to a hypothetical 'worst-case' increase in phosphorus loading. This evaluation suggested that lakes in the Alpine Lakes Wilderness Area generally are not sensitive to foreseeable increases in phosphorus loading because of their high rate of dilution and flushing. Pollutant-loading likelihood was evaluated according to the amount of seasonal 'wet area' near a lake and in the drainage basin. Of 298 lakes evaluated for pollutant-loading likelihood, 74 lakes were rated moderate to high. On the basis of these findings, lakes in the Alpine Lakes Wilderness Area are generally not considered susceptible to long-term degradation as a result of recreational use, but some lakes are probably susceptible to temporary local pollution. The nature of this potential problem, and knowledge of natural features of the Alpine Lakes Wilderness Area, suggest an approach for managing recreation so that the risk of water-quality degradation is minimized. (USGS)
W86-00114

**RESULTS OF AN ADAPTIVE ENVIRONMENTAL ASSESSMENT MODELING WORKSHOP-CONCERNING POTENTIAL IMPACTS OF DRILLING MUDS AND CUTTINGS ON THE MARINE ENVIRONMENT,**
Fish and Wildlife Service, Fort Collins, CO. Western Energy and Land Use Team.
G. T. Auble, A. K. Andrews, R. A. Ellison, D. B. Hamilton, and R. A. Johnson.
Available from the National Technical Information Service, Springfield, VA 22161, as PB83-114165. Environmental Research Laboratory, Gulf Breeze, FL. EPA-600/9-82-019. October 1982. 64 p. 33 Fig, 6 Tab, 14 Ref, 1 Append. Contract/Grant No. EPA-81-D-X0581.

Descriptors: *Drilling fluids, *Environmental effects, *Marine environment, Drilling cuttings, Bays, Drilling, Drilling mud, Gulf of Mexico.

This publication summarizes the findings of a workshop held September 14-18, 1981 between the United States Environmental Protection Agency and the United States Fish and Wildlife Service. Discussions focused on information pertaining to fate and effects, identification of general relationships between drilling mud fluids and the marine environment, and identification of site-specific variables likely to determine impacts of drilling muds and cuttings in various marine sites. The workshop was structured around the construction of a model simulating fate and effects of discharges from a single rig into open waters of the Gulf of Mexico. Factors that might produce different fate and effects in enclosed areas such as bays and estuaries also were discussed. Considerable knowledge (such as that concerning fate and physical effects of dredge spoil) that could be effectively employed in analysis of potential fate and physical effects in enclosed areas was identified.
W86-00147

**LABORATORY PROTOCOLS FOR EVALUATING THE FATE OF ORGANIC CHEMICALS IN AIR AND WATER,**
SRI International, Menlo Park, CA.
For primary bibliographic entry see Field 5A.
W86-00154

**LONG-TERM IMPACT OF DREDGED MATERIAL AT TWO OPEN-WATER SITES: LAKE ERIE AND ELLIOT BAY; EVALUATIVE SUMMARY,**
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
H. E. Tatem.
Technical Report D-84-5, November 1984. Final Report. 37 p, 4 Fig, 3 Tab, 8 Ref.

Descriptors: *Dredging, *Lake Erie, *Water pollution effects, *Solid waste disposal, *Ecological ef-

fects, Polychlorinated biphenyls, Microorganisms, Mollusks, Polychaetes, Benthos, Waste disposal, Water pollution.

Dredged material disposal sites in Lake Erie and Elliott Bay were studied in 1979-1980 and results were compared with those obtained in 1975-1976 from studies at the same sites. The Lake Erie disposal sites contained more gravel and sand than control areas. In general the microfaunal animals were less abundant at the Lake Erie disposal sites which were richer in meiofauna. No differences in Hg or Cd levels were found between disposal and control sites. The disposal mound created in 1975-1976 in Elliott Bay had stabilized physically and chemically. The mound area contained more animals than the surrounding bottom areas. Bivalves and polychaetes were the dominant animals found at the Elliott Bay disposal site. Some animals taken from the disposal mound contained polychlorinated biphenyls at levels slightly higher than sediment levels which were in the 2.0- to 3.0-ppm range.
W86-00160

**LONG-TERM IMPACT OF DREDGED MATERIAL DISPOSAL IN LAKE ERIE OFF ASHTABULA, OHIO,**
Weston (Roy F.), Inc., West Chester, PA.
K. J. Salamon.
Technical Report D-84-3, September 1984. Final Report. Army Engineer Waterways Experiment Station, Vicksburg, MS. 123 p, 41 Fig, 15 Tab, 40 Ref, 6 Append. Contract/Grant No. DACW39-79-C-0060.

Descriptors: *Dredging, *Sediment disposal, *Sediments, *Benthic fauna, *Ecological effects, *Heavy metals, Benthos, Aquatic animals, Mercury, Cadmium, *Dredging spoil, Bioaccumulation, Silt, Sand.

Animal, sediment, and water samples obtained from three Lake Erie disposal sites containing material dredged from Ashtabula Harbor were analyzed for sediment characteristics, benthic animals and Hg and Cd levels. Results were compared with those of two nearby reference areas and with results of studies conducted in 1975 and 1976. Disposal sites contained more gravel and sand than the reference sites which were predominantly silt and clay. A number of macrofauna and meiofauna benthic animals were found at both disposal and reference areas. In general, more macrofaunal animals and a greater variety of species were found at the reference areas. Only the macrofauna were statistically more abundant at the reference areas. Sediment analyses showed the reference or control areas contained higher levels of Hg compared to the disposal areas. For Cd the opposite was true. There were higher Cd levels at the disposal areas. The differences in metal concentrations at disposal and reference sites were not statistically significant. Tissue analyses showed that animals at the reference areas contained higher levels of Hg and Cd compared to disposal area animals.
W86-00162

**VOLUNTEER LAKE MONITORING, 1981,**
Illinois State Environmental Protection Agency, Springfield. Div. of Water Pollution Control.
D. F. Sefton, and J. R. Little.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-119180. Report No. IEPA/WPC/82-006, June 1982. 138 p, 20 Fig, 6 Tab, 28 Ref, 4 Append.

Descriptors: *Lakes, *Water pollution effects, *Monitoring, *Limnology, *Transparency, *Water quality, Illinois, Eutrophication, Stratification, Thermal stratification, Trophic level, Data acquisition, Glacial lakes, Lake morphology, Reservoirs, Lake classification, Aquatic life, Aquatic plants, Aquatic animals, Algae, Ecosystems, Food chains, Photosynthesis, Respiration, Lake stages, Water pollution sources, Water quality control, Septic tanks.

This report summarizes the methods and results of the Illinois EPA 1981 volunteer lake monitoring program. Secchi disc transparency, total depth, and field observations were recorded by 141 volunteers monitoring 87 lakes. Lakes ranged in transparency from 137.9 inches (Arbor in DuPage County) to 7.3 inches (Royal in Calhoun County). The clearest lakes were generally in the northwestern and southern part of the state; the most turbid, in the central and southcentral regions. Average transparencies of less than 4 ft (minimum recommended for bathing beaches) were reported in 63 of the 87 lakes. About 1/3 of the lakes had average values less than 2 ft, indicating use impairment problems. None of the monitored lakes were classified oligotrophic, 9 were mesotrophic, and the remainder were eutrophic. A primer of basic information on Illinois lakes for the layman is given. This includes origin, shape, hydrology, ecosystems, thermal stratification, succession and eutrophication, pollution, and water quality control measures.
W86-00200

**METHODS FOR ECOLOGICAL TOXICOLOGY: A CRITICAL REVIEW OF LABORATORY MULTISPECIES TESTS.**
Oak Ridge National Lab., TN. Environmental Sciences Div.
Ann Arbor Science, Ann Arbor, MI. 1981. Edited by Anna S. Hammons. 307 p.

Descriptors: *Water pollution effects, *Toxicology, *Chemical wastes, Ecological effects, Environmental effects, Aquatic habitats, Aquatic plants, Algae, Predation, Fish, Sediments, Zooplankton, Parasites, Population dynamics, Ecosystems, Mathematical models, Model studies, Invertebrates, Predation, Microorganisms, Arthropods, Insects, Soil, Litter, Animals, Plants, Mycorrhizae.

Selected laboratory methods for measuring ecological effects of toxic substances were critically evaluated. Criteria used in the evaluation were whether or not the tests were rapid, reproducible, relatively inexpensive, unequivocal, sensitive, socially relevant, predictive, generalizable, and well-developed. Tests recommended for research and development were as follows: in aquatic test systems--zooplankton-zooplankton predation tests, fish-zooplankton predation tests, parasitism, zooplankton-algal grazing tests, pelagic microcosms, and model streams; in terrestrial test systems--population interactions and ecosystems; and mathematical models--ecosystem paramater handbook, model validation methods, theoretical studies (multipopulation models, loop analysis, input-ouput analysis).
W86-00210

**SURVEY OF NATIONAL AND STATE REGULATORY AGENCY POLICY AND PROCEDURES FOR THE DETERMINATION OF THE TOXICITY OF WASTEWATER EFFLUENTS.**
Ecological Analysts, Inc., Sparks, MD.
For primary bibliographic entry see Field 6E.
W86-00211

**LONG-TERM ECOLOGICAL BEHAVIOUR OF ABANDONED URANIUM MILL TAILINGS; 2.: GROWTH PATTERNS OF INDIGENOUS VEGETATION ON TERRESTRIAL AND SEMI-AQUATIC AREAS,**
Toronto Univ. (Ontario). Inst. for Environmental Studies.
K. Kalin.
Report EPS 3/HA/2, December 1984. 98 p, 29 Fig, 17 Tab, 62 Ref.

Descriptors: *Water pollution effects, *Mine wastes, *Vegetation, *Uranium mill tailings, Spoil banks, Industrial wastes, Acid mine drainage, Trees, Cattails, Aquatic plants, Growth, Wetlands, Plant populations, Aspen trees, Birch trees.

The effect of abandoned or inactive uranium mill tailings on natural vegetation was studied in Ontario. Cattails have invaded the semi-aquatic areas. All communities were essentially monocultures of Typha latifolia, T. angustifolia, or T. glauca. Sedges, wool grass, and reed grass were found in transition zones between the cattails and the dry tailings. Cattail growth appeared to depend on the hydrological conditions, rather than on the chemical nature of the tailings. The root zones were less acidic than the soil surface. Decomposition coefficients of the cattail stands were comparable to those in control stands. Trees, mainly trembling aspens and white birch, have colonized the uranium tailings. Tree heights were similar regardless of site treatment (fertilizer and limestone application). However, when compared with trees in control sites, the trees appeared stunted and growing at their limits of ecological tolerance.
W86-00217

**GROUNDWATER MANAGEMENT STRATEGY FOR MICHIGAN: ECONOMIC AND SOCIAL IMPACTS OF GROUNDWATER CONTAMINATION; A CASE STUDY IN EAST BAY TOWNSHIP, GRAND TRAVERSE COUNTY, MICHIGAN.**
Northwest Michigan Regional Planning and Development Commission, Traverse City.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-132670. MI/DNR/GW-82/07, June 1982. 22 p. EPA Grant P00558801.

Descriptors: *Water pollution effects, *Groundwater pollution, *Water quality, *Water supply, Social impact, Economic impact, East Bay Township, Grand Traverse County, Michigan, Municipal water, Groundwater management, Local governments, Organic compounds, Attitudes, Public opinion, Water costs, Wells.

The social and economic impacts of groundwater contamination in East Bay Township, Grand Traverse County, Michigan, were surveyed in the Avenue E area where city water service was extended to potentially 102 homes. Contamination consisted of several toxic chemicals, which produced strong odor and foaming in the water supply. Most residents were retired or older working persons for whom additional expenses could significantly impact their budgets. The residents' perceptions of and reactions to their well water contamination were closely associated with what they could see or understand about water quality. All residents coped with the problems with varying degrees of hardship. The largest economic factor was the city water hookup. However, most residents had enough funds set aside for such an emergency. The contamination affected property values, a fact that most residents did not perceive. The most common social impact was lack of water. Other social impacts were frustration over the lack of information and over the water rate negotiations. All residents wanted the responsibility for the contamination resolved as a step toward cost reimbursement. In general the property owners' confidence in the government agencies involved in the problem did not diminish. The township government incurred costs of $13,200; the additional work was a major burden for the small staff.
W86-00218

**WORKING PAPERS PREPARED AS BACKGROUND FOR TESTING FOR EFFECTS OF CHEMICALS ON ECOSYSTEMS.**
National Research Council, Washington, DC. Committee to Review Methods for Ecotoxicology.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-132811. National Academy Press, Washington, DC. 1981. 257 p.

Descriptors: *Water pollution effects, *Fate of pollutants, Lakes, *Ecosystems, Toxicology, *Aquatic habitats, *Aquatic animals, *Environmental effects, Microenvironment, *Toxic wastes, *Ecotoxicology.

The eleven working papers in this volume were prepared for the study of the committee to Review Methods for Ecotoxicology. The charge to the Committee was to identify characteristics of ecological systems that would indicate hazardous effects of chemicals beyond the level of single species, to establish criteria for suitable testing schemes, and to evaluate the effectiveness of available test systems in assessing effects of chemicals within ecosystems. To assist in its deliberations on

the broad range of issues to be addressed, the Committee sought additional input from a number of experts. The working papers address a variety of topics: the use of microcosms as a testing scheme in terrestrial and aquatic systems; lethal gene distribution and diatoms as monitoring techniques for hazard assessment of chemicals in ecosystems; special problems associated with hazard assessment of wetlands and watersheds; approaches to assessing the environmental impact of radionuclide and xenobiotic organic substances; a general review of ecosystem properties relevent to ecotoxicology; and a discussion of the advantages and disadvantages of various classes of ecological tests. (Author)
W86-00230

**LAKES AND MICROCOSMS: EXTENDING MICROCOSM DATA TO AQUATIC ECOSYSTEMS,**
California Univ., Berkeley. Lawrence Berkeley Lab.
P. H. Gleick.
In: Working Papers Prepared as Background for Testing for Effects of Chemicals on Ecosystems, National Academy Press, Washington, DC. 1981. p 18-49, 76 Ref.

Descriptors: *Water pollution effects, *Lakes, *Aquatic habitats, *Ecosystems, *Microcosms, *Aquatic animals, Temperature, Nutrients, Fish, Plankton, Water quality, Transparency, Phosphorus, Biomass, Turbidity, Fish food, Phytoplankton, Algae, Oxygen depletion, Predation, *Microenvironment.

Microcosms can be used to determine the effects of toxic materials on aquatic ecosystems. One limitation of microcosms is the difficulty in accurately modeling certain important ecosystem parameters such as fish productivity, water transparency, odor, and disease vectors. These macrovariables are often influenced by microvariables (temperature, composition and productivity of plankton communities, water composition, and microbial decomposition activity). By analyzing in microcosms the effects of perturbations on microvariables, and by using field data on the correlations between these micro- and macrovariables, it is possible to deduce data on how a macrovariable may react to a given environmental perturbation. Among the most promising correlations are phosphorus levels with fish yields and transparency, total dissolved solids with standing crop of fish, and chemical concentration (e.g., ammonia) levels with oxygen depletion and fish kills.
W86-00231

**OPTIMUM MICROCOSMS FOR LAKE ECOTOXICOLOGY,**
California Univ., Berkeley. Lawrence Berkeley Lab.
J. Harte.
In: Working Papers Prepared as Background for Testing for Effects of Chemicals on Ecosystems, National Academy Press, Washington, DC. 1981. p 51-69, 16 Ref.

Descriptors: *Water pollution effects, *Lakes, *Aquatic habitats, *Ecosystems, *Microcosms, *Aquatic animals, *Toxicology, Gnotobiotic initiation, Whole-water-sample initiation, Surface growth, Biomass, Turbidity, Fish food, Phytoplankton, Algae, Oxygen depletion, Predation, Ecotoxicology, Microenvironment.

Many options are available for the design, initiation, and operation of lake-like microcosms. The choices selected will have a large influence on the realism of the results of ecotoxicological studies conducted with these microcosm. Hydraulically closed systems, initiated by the whole-water-sample method, and periodically poured into clean containers to prevent surface growth will behave most like the parent lake with respect to both chemical and biotic parameters. It is also likely that such systems will provide the most realistic information about the pathways and effects of toxic substances. Replicability is often poor when organisms are initially present in small numbers. Generally, no added replicability or realism is obtained by increasing the complexity and expense of the microcosm. For example, whole-water-sample initiation is easier than gnotobiotic initiation, closed systems are simpler than chemostats, and surface growth control by periodic pouring is easier than other means. However, this does not apply to incorporation of a benthic compartment in a microcosm.
W86-00232

**CHEMICALS AND WETLANDS,**
R. H. Kadlec.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-132811.
In: Working Papers Prepared as Background for Testing for Effects of Chemicals on Ecosystems, National Academy Press, Washington, DC. 1981. p 97-118, 42 Ref.

Descriptors: *Fate of pollutants, *Wastewater treatment, *Wetlands, *Chemicals, *Aquatic habitats, Water quality, Advanced wastewater treatment, Microbial degradation, Biodegradation, Biological wastewater treatment, Buffering, Nutrients, Nitrogen, Phosphorus, Aquatic plants, Heavy metals, Bottom sediments, Organic compounds, Halogenated hydrocarbons, Hydrocarbons, Biochemical oxygen demand, Chemical oxygen demand, Pathogens, Bacteria, Coliforms, Viruses.

Wetlands have certain characteristics which must be considered during an environmental assessment of toxic chemicals on the ecosystem. Wetlands appear to have a buffering systems (with respect to pH, alkalinity, and hardness), which tends to maintain a stationary operating point under natural and man-made stress. Water quality varies with time (diurnal, seasonal, historical) and water flow distance. The hydrologic regime must be fully understood the understand the variation of chemical parameters. Sediment is the site of action for most uptakes and initial storages of chemicals. Uptake by plants and subsequent return to the sediment often takes many months, while epiphytes perform similarly, but on a time scale of hours. Nitrogen and phosphorus show a cyclic behavior, and microbial processes are very important in nutrient uptake processes. Heavy metals are absorbed aquatic plants and sediments, with more entering the sediments in most wetlands. Refractory chemicals such as hydrocarbons or halogenated hydrocarbons are often slowly degraded by microbial processes. Advanced wastewater treatment using wetlands usually has excellent BOD and COD reduction. The fate of viruses and bacteria in wastewater applied to wetlands has been studied with variable results.
W86-00233

**ECOTOXICOLOGY AT THE WATERSHED LEVEL,**
Pacific Northwest Forest and Range Experiment Station, Corvallis, OR. Forestry Sciences Lab.
For primary bibliographic entry see Field 5B.
W86-00234

**UTILITY OF SINGLE SPECIES AND ECOSYSTEM TESTS IN ASSESSING THE ENVIRONMENTAL IMPACT OF RADIONUCLIDE ECOTOXICANTS,**
Emory Univ., Atlanta, GA. Dept. of Biology.
For primary bibliographic entry see Field 5B.
W86-00235

**CLASSES OF ECOTOXICOLOGICAL TESTS: THEIR ADVANTAGES AND DISADVANTAGES FOR REGULATION,**
California Univ., Berkeley. Lawrence Berkeley Lab.
R. A. Schneider.
In: Working Papers Prepared as Background for Testing for Effects of Chemicals on Ecosystems, National Academy Press, Washington, DC. 1981. p 175-191, 24 Ref.

Descriptors: *Water pollution effects, *Aquatic habitats, *Microcosms, *Ecosystems, *Toxicology, Single species tests, *Environmental effects, Field tests, *Ecotoxicology, Microenvironment,.

Three classes of ecotoxicological tests, single-species, microcosm, and field tests, are discussed and evaluated for their usefulness in toxic substance regulation. Criteria for evaluation are ability to predict ecosystem-level effects, replicability, standardizability, speed, simplicity, and cost. The major conclusion is that microcosms of intermediate complexity and small field plots are presently the most useful tools for ecotoxicological testing and hazard evaluation. (Author)
W86-00236

**ECOSYSTEM APPROACH TO THE TOXICOLOGY OF RESIDUE FORMING XENOBIOTIC ORGANIC SUBSTANCES IN THE GREAT LAKES,**
Environmental Research Lab.-Duluth, Grosse Ile, MI. Large Lakes Research Station.
For primary bibliographic entry see Field 5B.
W86-00237

**RESTORATION OF HABITATS IMPACTED BY OIL SPILLS.**
Butterworth, Boston. 1984. Edited by John Cairns, Jr. and Arthur L. Buikema, Jr. 182 p.

Descriptors: *Oil spills, *Ecological effects, *Oil pollution, Symposium, *Water pollution effects, *Water pollution control, *Cleanup operations, Tidal flats, Salt marshes, Coral reefs, Mangrove swamps, Beaches, Shores, Sea grasses, Tundra, Habitats, Fisheries, Environmental impact statement, Conferences, Ecosystems.

This book presents reports of a workshop held at the Virginia Polytechnic Institute and State University on November 9-11, 1981. The workshop convened scientists from various backgrounds to review the problem of oil spills and determine courses of action that may include possible means for restoration of impacted habitats. Seven chapters authored by different scientists cover the following topics: recovery and restoration of rocky shores, sandy beaches, tidal flats, and shallow subtidal bottoms impacted by oil spills; the effects of oil on seagrass ecosystems; the recovery and restoration of salt marshes and mangroves following an oil spill; measurements of damage, recovery, and rehabilitation of coral reefs exposed to oil; oil spill damage and recovery in tundra and taiga; fisheries resource impacts from spills of oil or hazardous subtances; and a workshop summary.
W86-00239

**RECOVERY AND RESTORATION OF ROCKY SHORES, SANDY BEACHES, TIDAL FLATS, AND SHALLOW SUBTIDAL BOTTOMS IMPACTED BY OIL SPILLS,**
Stockholm Univ. (Sweden). Dept. of Zoology.
B. Ganning, D. J. Reish, and D. Straughan.
In: Restoration of Habitats Impacted by Oil Spills, Butterworth, Boston. 1984. Edited by John Cairns, Jr. and Arthur L. Buikema, Jr., p 7-36, 5 Fig, 5 Tab, 96 Ref.

Descriptors: *Oil spills, *Oil pollution, *Cleanup operations, *Ecological effects, *Literature reviews, *Water pollution effects, Aquatic organisms, *Littoral environments, Tidal flats, Shores, Environmental effects, Intertidal areas, Beaches.

A review of the literature on oil spills on rocky shores shows that the intertidal organisms in this type of environment exhibit considerable tolerance to oil pollution. Most damage from oil coating leads to suffocation or loss of attachment to the substrate. On sandy intertidal shores of tidal flats, the impact is increased by the persistence of oil in unconsolidated substrates. In subtidal sediment bottoms, the sensitivity to oil pollution is greater than in shallow sediment habitats since the organisms are living in fairly stable environments. Oil spill impact and effects of cleanup operations are more closely related to seawater temperatures than to latitude. Areas with large tidal amplitude suffer less from oil pollution than do low tidal or nontidal areas. Seasonality affects the impact of oil spills, especially when the spill takes place after reproduction and hatching. Areas having salinities dif-

fering from those of normal seawater suffer more stress when subjected to oil pollution due to increased inherent physiological stresses. For rocky shores, cleanup of oils by natural recovery processes is usually recommended. If mechanical removal of oil-contaminated sand is not feasible, then the polluted area should be left to natural recovery methods. Disposal of materials from cleanup operations is best done at oil refineries.
W86-00240

**EFFECTS OF OIL ON SEAGRASS ECOSYSTEMS,**
Virginia Univ., Charlottesville. Dept. of Environmental Sciences.
J. C. Zieman, R. Orth, R. C. Phillips, G. Thayer, and A. Thorhaug.
In: Restoration of Habitats Impacted by Oil Spills, Butterworth, Boston. 1984. Edited by John Cairns, Jr. and Arthur L. Buikema, Jr., p 37-64, 5 Fig, 1 Tab, 82 Ref.

Descriptors: *Sea grasses, *Aquatic plants, *Ecosystems, *Oil spills, *Oil pollution, *Ecological effects, *Water pollution effects, *Cleanup operations, Fouling, Littoral zones, Environmental effects, Habitats, Dispersants, Toxicity, Intertidal areas, Literature reviews.

A review of seagrass ecology is given to facilitate a discussion of the effects of oil spills on one of the most productive ecosystems known. Physically, seagrasses prevent erosion and stabilize the effects of tidal actions and provide habitats for numerous epiphytic organisms. Biologically, seagrasses perform an essential cycling of nutrients by absorbing P through the roots and leaves and returning both N and P to the water column from sediments via the plant. Seagrass ecosystems can be damaged by oil through direct suffocation or fouling of organisms or destruction of food sources or habitats. Oil pollution can affect the food market value of seagrass fisheries by tainting of flavor. Studies in the literature of major oil spills indicate that the greatest damage to aquatic organisms seems to be from aromatic hydrocarbon fractions of oil. The effects of oil dispersants on seagrass communities are not known. Inert absorbents present little hazard to seagrass systems if properly used. The normal recovery of seagrass systems from oiling depends on the extent of damage to sediments. Efforts of restoring oil-damaged seagrass systems by transplanting plugs or shoots have met with variable success. It is suggested that research be carried out on the toxicity levels of the major hydrocarbon substances on the major seagrass species in laboratory and field tests.
W86-00241

**RECOVERY AND RESTORATION OF SALT MARSHES AND MANGROVES FOLLOWING AN OIL SPILL,**
Research Planning Inst., Inc., Columbia, SC.
C. D. Getter, G. Cintron, B. Dicks, R. R. Lewis, and E. D. Seneca.
In: Restoration of Habitats Impacted by Oil Spills, Butterworth, Boston. 1984. Edited by John Cairns, Jr. and Arthur L. Buikema, Jr., p 65-113, 7 Fig, 4 Tab, 121 Ref.

Descriptors: *Mangrove swamps, *Marshes, *Oil spills, *Oil pollution, *Ecological effects, *Water pollution effects, *Cleanup operations, *Literature reviews, Wetlands, Dispersants, Ecosystems, Marsh plants, Swamps, Environmental effects.

Oil impacts to marshes will vary with amount of oil spilled, oil type, magnitude of cleanup activities, physical and biological structure of the marsh, latitude and season. Persistence of damage and recovery of the system depend on physical, chemical, and biotic factors such as weathering rate and degree of oil removal, availability of propagules, successional processes, sediment erosion/accretion, and restorative activities by man. Mangrove forests have different reactions to oil pollution, depending on mangrove types. Basin forests are already subjected to high natural stresses and may be more sensitive to additional stresses. If mangrove overwash islands are isolated from normal waves, they can be more severely damaged by the stranding of oil in them. Most protective techniques are unlikely to damage marsh ecosystems, but the effects of oil-dispersant mixtures are not known. Foot and equipment traffic during cleanup of oil spills may produce adverse effects on marshes but not usually on mangroves. Techniques for restoring oiled marsh and mangrove areas include transplanting, fertilization, direct seeding, planting of propagules, seedlings or small trees. Research gaps include the effects of dispersants and herding compounds on marshes and mangroves, evaluation of cleanup techniques, studies on animal species of marshes and mangroves, follow-up studies of spill sites, growth of plants on oiled substrates and experimental restoration techniques.
W86-00242

**MEASUREMENTS OF DAMAGE, RECOVERY, AND REHABILITATION OF CORAL REEFS EXPOSED TO OIL,**
Continental Shelf Associates, Inc., Boulder, CO.
K. W. Fucik, T. J. Bright, and K. S. Goodman.
In: Restoration of Habitats Impacted by Oil Spills, Butterworth, Boston. 1984. Edited by John Cairns, Jr. and Arthur L. Buikema, Jr., p 115-133, 3 Fig, 2 Tab, 62 Ref.

Descriptors: *Coral reefs, *Oil spills, *Corals, *Oil pollution, *Dispersants, *Water pollution effects, *Ecological effects, *Cleanup operations, Environmental effects, Coelenterates, Oil recovery, Ecosystems, Oil.

The Arabian Gulf and the Greater Caribbean are two well developed coral reef areas that receive much petroleum activity through the traffic of oil transporting tankers. Prespill mapping of coral reefs, a technique useful in the prevention and cleanup of oil spills, has been applied only to some reef areas. The sensitivity of reef ecosystems to oil spills is increased if the reef is of the emergent of shallow submergent type. Mechanized techniques such as skimmers do not cause oil to become incorporated into the water column. Currently available dispersants produce temporary stress reactions in corals in laboratory tests. Particulate sinking agents should be avoided in the cleanup of oil spills near coral reefs. To assess the damage and recovery of coral reefs to oil pollution, studies at the organismal level should be conducted before community level impacts are examined. Difficulty arises in assessing the recovery of reefs from oil spills because little data exists for comparative purposes and recovery is a long term process. Reef rehabilitation may by transplanting coral planulae. More field studies are needed on the recovery after oil spills of complex coral reef systems.
W86-00243

**FISHERIES RESOURCE IMPACTS FROM SPILLS OF OIL OR HAZARDOUS SUBSTANCES,**
Environmental Research Lab., Gulf Breeze, FL.
W. P. Davis, D. E. Hoss, G. I. Scott, and P. F. Sheridan.
In: Restoration of Habitats Impacted by Oil Spills, Butterworth, Boston. 1984. Edited by John Cairns, Jr. and Arthur L. Buikema, Jr., p 157-172, 1 Tab, 37 Ref.

Descriptors: *Oil spills, *Fisheries, *Environmental impact statement, *Oil pollution, *Water pollution effects, *Ecological effects, *Marine fisheries, *Economic aspects, Environmental effects, Fish, Toxicity, Oil, Fish stocking, Aromatic compounds, Cleanup operations, Shellfish.

Studies have shown that, in general, refined petroleum products are more toxic than crude oils to marine organisms. The toxicity of aromatic hydrocarbons increases with increasing molecular size. To protect identified fisheries from oil spills, shellfish may be harvested in 'fenced off' areas or be transferred to safer areas prior to contamination. Attempts to obtain comparative assessments of impacts on fisheries have been made during a number of oil spills by using such techniques as echo sounding, species counting, aerial observations, and grid sampling methods. In Japan, the help of fishermen was enlisted when oil threatened a major fishery. All catches were carefully monitored for contamination and economic damages were calculated. Population restoration after oil spills can be accomplished by restocking. Areas that require further study are the relation of species or population stress to actual impact, use of dispersants, determination of recovery times, measurement techniques for sublethal effects and continued monitoring of spill areas to evaluate effectiveness of restoration efforts.
W86-00244

**EFFECTS, PATHWAYS, PROCESSES, AND TRANSFORMATION OF PUGET SOUND CONTAMINANTS OF CONCERN,**
E.V.S. Consultants Ltd., North Vancouver (British Columbia).
For primary bibliographic entry see Field 5B.
W86-00293

**ETHYLENE: ENVIRONMENTAL AND TECHNICAL INFORMATION FOR PROBLEM SPILLS.**
Environmental Protection Service, Ottawa (Ontario).
August 1984. 58 p, 15 Fig, 6 Tab, 137 Ref.

Descriptors: *Water pollution effects, *Fate of pollutants, *Ethylene, *Hydrocarbons, *Chemical spills, *Spills, *Aquatic life, *Toxicity, *Water pollution prevention, Transportation, Lakes, Fishkill, Environmental effects, Pollutant identification, Chemical properties, Physical properties.

Information useful for designing countermeasures for ethylene spills and for assessing their effects on the environment includes a summary of pertinent data, chemical and physical properties, production and transportation, fate in the environment, toxicity to aquatic life and other organisms, suggested countermeasures, and analytical methods. When spilled into water, liquid ethylene simultaneously vaporizes and spreads on the surface. It is relatively insoluble in water. Nomograms are given for calculating rate of spreading on still water. The 4-day medium lethal toxicity rating for aquatic life is 1000 to 100 mg per liter. A fishkill is reported in fresh water at a concentration of 22-252 mg per liter and exposure of 1 hr. Ethylene disperses rapidly without bioaccumulation or food chain contamination potential. If necessary, ethylene-contaminated water may be aerated. Since chlorination in the presence of ethylene can form dichloroethane, drinking water contaminated with ethylene should be aerated before chlorination.
W86-00303

## 5D. Waste Treatment Processes

**EFFECTS ON GROUNDWATER QUALITY OF THE INTRODUCTION OF SECONDARY SEWAGE TREATMENT TO AN EFFLUENT RECHARGE SITE ON THE CHALK OF SOUTHERN ENGLAND,**
Water Research Centre, Marlow (England).
K. M. Baxter.
Journal of Hydrology, Vol. 77, p 333-359, 1985. 8 Fig, 7 Tab, 16 Ref. Commission of the European Commmunities contract ENV-399-UK(N).

Descriptors: *Groundwater contamination, *Secondary wastewater treatment, *Artificial recharge, *England, *Chalk aquifer, Wastewater disposal, Wastewater treatment, Effluent, Recharge, Fate of pollutants.

Detailed investigations were carried out at a site on the Chalk of southern England between 1978 and 1982 to determine the effects of sewage effluent recharge on groundwater quality. Before 1981 screened crude domestic sewage was recharged to the Chalk via a series of lagoons. During 1981 a secondary-treatment works was commissioned on the site and the effluent recharged through a new subsurface drain network. Monitoring of the inorganic, organic and microbiological quality of effluent and groundwater continued through the change-over, enabling the effects of the new regime to be assessed. The recharge of sewage effluent to groundwater was shown to be an effec-

tive way of ameliorating the effluent quality. Following the introduction of secondary treatment at the site there seems to have been little change in the degree of contaminant removal. (Author's abstract)
W86-00043

**WASTEWATER REUSE AND EXPOSURE TO LEGIONELLA ORGANISMS,**
Hadassah Medical School, Jerusalem (Israel). Environmental Health Lab.
For primary bibliographic entry see Field 5C.
W86-00054

**TOXIC ORGANICS REMOVAL KINETICS IN OVERLAND FLOW LAND TREATMENT,**
Cold Regions Research and Engineering Lab., Hanover, NH.
T. F. Jenkins, D. C. Leggett, L. V. Parker, and J. L. Oliphant.
Water Research, Vol. 19, No. 6, p 707-718, 1985. 4 Fig, 11 Tab, 32 Ref.

Descriptors: *Toxic substances, *Organic compounds, *Wastewater treatment, *Land treatment, *Overland flow, Water treatment, Volatilization, Adsorption, Sorption.

The efficiency in removing 13 trace organics from wastewater was studied on an outdoor, prototype overland flow land treatment system. More than 94% of each substance was removed at an application rate of 0.4 cm/h (0.12 cu m/h/m of width). The % removals declined as application rates were increased. Removal from solution was described by first-order kinetics. A model based on the two-film theory was developed using three properties of each substance (the Henry's constant, the octanol-water partition coefficient and the molecular weight) and two system parameters (average water depth and residence time). The dependence of the removal process on temperature was consistent with the known dependence of Henry's constant and diffusivity on temperature. The model was tested on a second overland flow system. (Author's abstract)
W86-00057

**COMPUTER SIMULATION OF AN INDUSTRIAL WASTEWATER TREATMENT PROCESS,**
Montana Coll. of Mineral Science and Technology, Butte. Dept. of Chemistry and Geochemistry.
D. R. Jenke, and F. E. Diebold.
Water Research, Vol. 19, No. 6, p 719-724, 1985. 1 Fig, 6 Tab, 7 Ref. U.S. Bureau of Mines grant J0295042.

Descriptors: *Computer models, *Wastewater treatment, *Industrial wastewater, Mixing, Lime, Acid mine drainage, Mine drainage, Acid streams, Chemical reactions.

The computer program REDEQL.EPAK has been modified to allow for the prediction and simulation of the chemical effect of mixing two or more aqueous solutions and one or more solid phases. In this form the program is capable of modelling the lime neutralization treatment process for acid mine waters. In its present form, the program calculates the speciation of all influent solutions, evaluates the equilibrium composition of any mixed solution and provides the stoichiometry of the liquid and solid phases produced as a result of the mixing. The program is used to predict the optimum treatment effluent composition, to determine the amount of neutralizing agent (lime) required to produce this optimum composition and to provide information which defines the mechanism controlling the treatment process. (Author's abstract)
W86-00058

**TOXICITY TO DAPHNIA OF THE END PRODUCTS OF WET OXIDATION OF PHENOL AND SUBSTITUTED PHENOLS,**
Michigan Technological Univ., Houghton. Dept. of Biological Sciences.
R. Keen, and C. R. Baillod.
Water Research, Vol. 19, No. 6, p 767-772, 1985. 6 Fig, 5 Tab, 12 Ref. EPA grant R805565-010.

Descriptors: *Toxicity, *Daphnia, *Water pollution effects, *Wet oxidation, *Phenols, Wastewater treatment, Oxidation, Bioassays, Water treatment.

The process of wet oxidation breaks down organic substances in aqueous solution at elevated temperatures and pressures. Experimental wet oxidations were carried out on pure solutions of phenol, 2-chlorophenol and 4-nitrophenol. After 1-h wet oxidation, final concentrations of these compounds averaged 3% of their concentrations in the starting solutions. The toxicities of the starting compounds and the residual toxicity of the end-product solutions were measured with 48-h acute toxicity tests using Daphnia magna. The solutions of end products were all less toxic than the starting solutions by factors ranging from 10 to 120. However, the end-product solutions were somewhat more toxic than would be predicted from the known concentration of initial compound remaining in the solution of end products. (Author's abstract)
W86-00064

**POINT SOURCES-NONPOINT SOURCES TRADING IN THE LAKE DILLON WATERSHED.**
Northwest Colorado Council of Governments, Frisco.
For primary bibliographic entry see Field 5B.
W86-00167

**DEPOSIT CONTROL TECHNOLOGY FOR KRAFT RECOVERY UNITS,**
New Jersey Dept. of Environmental Protection, Trenton. Div. of Water Resources.
H. N. Tran.
Environmental Protection Service, Ottawa, Ontario. Report EPS 3/PF/1, December 1984. 26 p, 21 Fig, 2 Tab, 7 Ref.

Descriptors: *Wastewater treatment, *Industrial wastes, *Pulp and paper industry, *Kraft mills, *Pulp wastes, Bleaching wastes, Waste recovery, Automation, Monitoring, Economic aspects, Models.

This report describes the development of an on-line instrument for measuring the rate of accumulation of fireside deposits in the superheater and boiler sections of kraft recovery units. The recovery unit eliminates the lignin and other wood components dissolved in the black liquor and recovers and regenerates the inorganic pulping chemicals while producing steam for power generation and process heating. Large accumulations of fireside deposits plug flue gas passages and ultimately limit kraft recovery unit capacity and pulp mill production. Sootprobe offers the opportunity for increased pulp production through improved deposit control. It is estimated that, in a nominal 750-ton/day kraft mill, the use of this technology would result in an incremental pulp production of $26 million/yr, and an energy savings of $200 thousand. Results of three trials of the research models of sootprobe at a kraft mill in Ontario show that the accumulation of deposits in the superheater and boiler bank regions in kraft recovery units can be continuously measured using sootprobe. The signal from sootprobe is reliable. Sootprobe can be used to monitor flue gas temperatures. Deposit accumulation rates in the superheater and boiler bank regions vary significantly at the same black liquor firing load. Sootprobe provides a feedback signal to the operator so that he can adjust firing conditions to minimize deposit accumulation rate.
W86-00170

**ENVIRONMENTAL ENGINEERING,**
Duke Univ., Durham, NC. Dept. of Civil and Environmental Engineering.
For primary bibliographic entry see Field 5F.
W86-00188

**FLOW BALANCING METHOD FOR STORMWATER AND COMBINED SEWER OVERFLOW,**
Swedish Council for Building Research, Stockholm.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-124453. 1982. 27 p, 8 Fig, 5 Photos.

Descriptors: *Wastewater treatment, *Flow control, *Equalizing, *Lake restoration, *Storm wastewater, *Combined sewer overflows, Peak flow, Varied flow, Water pollution control, Runoff, Storm runoff, Overflow.

A low-cost flow balancing plant for storm water discharges and combined sewer overflows was demonstrated at Lake Trehorningen near Stockholm, Sweden. Floating tanks consisting of pontoons with reinforced vertically hanging plastic curtains are anchored to the bottom of the receiving water body. They operate as a horizontally working balancing system using the plug flow principle. The surrounding water functions as a balancing medium. When storm water discharge exceeds the pumping capacity of the treatment plant, the polluted storm water pushes the lake water from one floating tank compartment to the next in the flow direction. When storm water discharge is less than the pumping capacity of the treatment plant, the flow is reversed, allowing lake water to successively enter the floating tank compartments. During dry weather lake water may be pumped through the treatment plant to improve water quality. Experiences at three similar installations are described.
W86-00191

**DEVELOPMENT DOCUMENT FOR EFFLUENT LIMITATIONS GUIDELINES AND STANDARDS FOR THE TEXTILE MILLS POINT SOURCE CATEGORY.**
Environmental Protection Agency, Washington, DC. Effluent Guidelines Div.
For primary bibliographic entry see Field 5G.
W86-00207

**OIL SHALE MINING, PROCESSING, USES, AND ENVIRONMENTAL IMPACTS, AUGUST, 1981-OCTOBER, 1982: CITATIONS FROM THE NTIS DATA BASE.**
National Technical Information Service, Springfield, VA.
Available from the National Technical Information Sevice, Springfield, VA 22161 as PB83-801365. December 1982. 183 p.

Descriptors: *Mine wastes, *Bibliographies, *Oil shale, *Industrial wastes, *Wastewater treatment, *Water pollution control. *Water quality control, Gasification, Pollutant identification, Leachates, Shales, Environmental effects, Ecological effects, Groundwater pollution, Streams, Water requirements.

This bibliography contains 183 abstracts of government-funded research on oil shale. Among the water-related subjects are water pollution control, waste and wastewater characterization and treatment, leachates, effect on groundwater and stream water quality, environmental and ecological impacts of wastes, water requirements, social and economic impacts, and hydrological aspects. All these entries are new since the last edition.
W86-00215

**NEW CONCEPTS AND PRACTICES IN ACTIVATED SLUDGE PROCESS CONTROL,**
Arthur Technology, Inc., Fond du Lac, WI.
R. M. Arthur.
Activated Sludge Process Control Series, Ann Arbor Science, Ann Arbor, MI. 1982. 125 p.

Descriptors: *Wastewater treatment, *Activated sludge, *Biological wastewater treatment, *Monitoring, *Process control, *Activated sludge process, *Aeration, *Mixed liquor solids, Sludge, Suspended solids, Denitrification, Control systems, Systems engineering.

Process control in the wastewater treatment plant is the responsibility of the plant operator. The engineer aids the plant operator in his job by

designing a plant which has the flexibility and controllability needed to produce high quality effluents. On-line instrumentation provides the basis for process control. In conventional plug flow activated sludge plant, aeration, return of settled sludge, and mixed liquor suspended solids are controllable elements. Conventional activated sludge systems can be modified by contact stabilization, extended aeration, and use of pure oxygen. Control methods may be manual or of the microprocessor, computer control or adaptive control types. Control modes available are on-off controls, ratio control, proportional control, proportional plus integral control, and proportional plus derivative control. The four measurements of the biological system important in process control include progress of metabolism, the state of denitrification, the concentration of viable microorganisms and the aerobic-anaerobic stage of respiration. The sensors that are available to monitor these factors are discussed along with various control schemes for the activated sludge process.
W86-00221

**CHEMICALS AND WETLANDS,**
For primary bibliographic entry see Field 5C.
W86-00233

**MODELING OF AN ANFLOW MUNICIPAL WASTE-TREATMENT UNIT,**
Massachusetts Inst. of Tech., Oak Ridge, TN. School of Chemical Engineering Practice.
D. J. Halbert, and R. J. Wojtowicz.
Available from the National Technical Information Service, Springfield, VA 22161 as DE82-16617. ORNL/MIT-342, June 1982. 65 p, 10 Fig, 7 Tab, 21 Ref, Contract/Grant No. W-7405-eng-26.

Descriptors: *Wastewater treatment, *Anaerobic digestion, *Model studies, Biological wastewater treatment, ANFLOW reactor, Computer programs, Methane, Kinetics, Upflow reactor.

A computer program, ANFLOW.F4, was written to model the anaerobic upflow, or ANFLOW bioreactor, developed in the Chemical Technology Division at Oak Ridge National Laboratory. The program predicts sludge accumulation rates, effluent liquid composition, and effluent gas flow rate and composition as a function of time following a change in inlet flow rate or composition. The model can be used to qualitatively study ANFLOW behavior. The ANFLOW reactor was modeled as a settling tank and a series of continuous stirred-tank reactors (CSTR). Residence-time-distribution experiments on the uninoculated column indicate that it is best modeled by two to five CSTRs in series. The number of CSTRs was left as an input parameter in the computer program. A reaction scheme based on conversion of soluble chemical oxygen demand first to volatile acids by acetogenic bacteria and then to methane and carbon dioxide by methanogenic bacteria was selected. Monod and inhibition kinetics were used for acetogenesis and methanogenesis, respectively. Material balances were written for 14 components in each CSTR. Kinetic and equilibrium constants were extracted from the literature, and a numerical integration technique was used to solve the time-dependent steady-state solutions of the material balances. The program was successfully tested for one CSTR. (Author)
W86-00246

**EVALUATION OF THE 'LECTRO CLEAR Z' ELECTROCOAGULATION PROCESS FOR MEAT PACKING WASTEWATER TREATMENT.**
Western Industrial Labs. Ltd., Edmonton (Alberta).
Report No. EPS 4-WP-82-1, January 1982. Environmental Protection Service, Ottawa, Ontario. 92 p, 4 Fig, 4 Tab, 4 Append.

Descriptors: *Wastewater treatment, *Meat processing industry, *Flotation, Lectro Clear Z unit, Industrial wastewater, Biological wastewater treatment, Coagulation.

The Lectro Clear Z unit is used to pretreat wastes from a meat packing plant in Lethbridge, Alberta. The unit's basic principle is formation of a floc by adjustment of the wastewater pH to 4.0-4.5 with sulfuric acid or sodium hydroxide, addition of chemical, and electrolysis to form hydrogen and oxygen. The gas bubbles float the floc to the surface where it is skimmed. Average BOD in the influent wastewater is 647 mg per liter; average effluent, 284 mg per liter, with a removal of 50%-70%. Suspended solids removals are 68%, from an average of 522 to 173 mg per liter.
W86-00252

**ANNOTATED BIBLIOGRAPHY ON NORTHERN ENVIRONMENTAL ENGINEERING, 1978-1979,**
Environmental Protection Service, Ottawa (Ontario). Water Pollution Control Directorate.
For primary bibliographic entry see Field 10C.
W86-00289

## 5E. Ultimate Disposal Of Wastes

**SEAWATER CIRCULATION IN SEWAGE OUTFALL TUNNELS,**
New South Wales Univ., Kensington (Australia). Water Research Lab.
D. L. Wilkinson.
Journal of Hydraulic Engineering, Vol. 111, No. 5, p 846-857, May, 1985. 6 Fig, 1 Tab, 3 Ref.

Descriptors: *Seawater, *Saline water intrusion, *Wastewater outfall, *Outfall tunnels, Tunnels, Design criteria, Wastewater disposal, Model studies.

As a means of maintaining water quality along the foreshores, sewage wastes at certain sites have been conveyed offshore through tunnels excavated beneath the sea floor and released into the ocean through a series of vertical shafts or risers. The risers are typically 2 to 5 km offshore. The failure of the outfalls at Aberdeen (Scotland) and Weymouth (England) to function as originally planned has been attributed to the intrusion of seawater into the outfall tunnel. Model studies showed that the dense seawater can form a wedge structure in the tunnel which completely blocks the sewage discharge from the more seaward risers; seawater circulates through the more seaward risers to be discharged into the ocean through the riser located immediately above the wedge. A different mode of blocking called circulation blocking occurs when seawater is drawn down the more shoreward risers and a mixture of sewage and seawater discharges from the seaward risers. The magnitude of the circulation was determined in terms of the sewage flow and geometric parameters of the outfall. An expression was derived for the sewage flow required to arrest the circulation. Circulation blocked outfalls will clear when the sewage inflow exceeds a critical flow rate; however, like wedge blocked outfalls, the flow required to achieve is many times greater than the flow needed to prevent intrusion into the diffuser ports. Tunnelled ocean outfalls should be constructed with the design capacity discharge required to purge an outfall subject to circulation blocking. (Collier-IVI)
W86-00017

**DIGITAL SIMULATION OF THE REGIONAL EFFECTS OF SUBSURFACE INJECTION OF LIQUID WASTE NEAR PENSACOLA, FLORIDA,**
Geological Survey, Tallahassee, FL. Water Resources Div.
For primary bibliographic entry see Field 5B.
W86-00122

**POTENTIAL FOR CONTAMINATION OF SHALLOW AQUIFERS IN ILLINOIS,**
Illinois State Geological Survey Div., Champaign.
R. C. Berg, J. P. Kempton, and K. Cartwright.
Circular 532, 1984. 30 p, 12 Fig, 2 Tab, 2 Plates, 40 Ref.

Descriptors: *Aquifers, *Waste disposal, *Geological mapping, *Groundwater pollution, *Illinois, Mapping, Geohydrology, Geological surveys, Municipal wastes, Solid waste disposal, Underground waste disposal.

The potential for contaminating groundwater resources is a critical concern in Illinois. Contamination may result from land burial of municipal wastes and surface or near-surface disposal of wastes. Aquifers are susceptible to contamination because their hydrogeologic properties allow waste effluents to travel rapidly. Whether a shallow aquifer actually becomes contaminated also depends on the properties of the earth/geologic materials that surround it. The purpose of this project was to describe and map geologic materials to a depth of 50 ft throughout the state of Illinois. The combination of hydrogeologic properties and stratigraphic position of geologic materials provides the basis for mapping the potential for contaminating aquifers. Two maps constructed for this study show the distribution of sequences of geologic materials and their comparative ratings. Each sequence was rated for the susceptibility of its water-yielding materials (aquifers) to contamination from waste-disposal practices. The maps are presented at a scale of 1:500,000 for the entire state. They may be used for suggesting areas where disposal of wastes will have minimum potential for contaminating groundwater resources and for screening areas with low contamination potential as part of the process of locating new disposal sites.
W86-00178

**MODIFICATION OF BELL CANYON TEST (BCT) 1-FF GROUT,**
Army Engineer Waterways Experiment Station, Vicksburg, MS. Structures Lab.
For primary bibliographic entry see Field 8G.
W86-00248

## 5F. Water Treatment and Quality Alteration

**ADVANTAGES OF DISSOLVED-AIR FLOTATION FOR WATER TREATMENT,**
Water Research Centre, Stevenage (England).
T. Zabel.
American Water Works Association, Vol. 77, No. 5, p 42-46, May, 1985. 4 Fig, 3 Tab, 13 Ref.

Descriptors: *Dissolved-air flotation, *Water treatment, *Physicochemical treatment, Design criteria, Algae, Sedimentation, Flocculation, Coagulation, Turbidity, Softness.

Many raw water sources contain low-density particles such as algae, which, because of their tendency to float, cause problems in the sedimentation stage. In particular, nutrient-rich stored waters that may contain heavy algae blooms are difficult to treat by sedimentation. In addition, treatment of low turbidity, soft, highly colored waters produces very light flocs that settle very slowly. Dissolved-air flotation as a primary clarification stage for the production of potable water is particularly effective for the treatment of these waters. Dissolved-air flotation plants consist of a facility to mix the coagulation chemicals with the raw water and a mechanical flocculation stage, followed by a flotation tank. Part of the treated water is recycled, pressurized, and saturated with air and then introduced to the flocculated water stream via a bank of air injection nozzles. The pressure is reduced to atmospheric pressure across the nozzles thus releasing the air in the form of fine bubbles. The air bubbles attach themselves to the flocs and the bubble-floc agglomerates rise to the surface of the flotation tank and are removed as floated sludge either by flooding or mechanical scraping. Flotation has several process advantages over sedimentation: It can produce better water quality; it can be operated at high surface loadings, resulting in relatively small and shallow plants; and it can be started up quickly, with a steady water quality being achieved within 45 min. Also, the solids concentration of the sludge produced is significantly higher (about 3 percent) than that of sludge produced by sedimentation. Detailed information

is given on the design of flocculation and flotation tanks, the air saturation system, the production of microbubbles, and the different sludge removal systems that can be used. Performance data are given for flotation plants used for clarification of several raw waters, with special emphasis on the treament of algae-laden waters and low-turbidity, highly colored waters. (Collier-IVI)
W86-00005

**REMOVING BARIUM AND RADIUM THROUGH CALCIUM CATION EXCHANGE,**
CH2M Hill, Milwaukee, WI.
A. G. Myers, V. L. Snoeyink, and D. W. Snyder.
Journal of the American Water Works Association, Vol. 77, No. 5, p 60-66, May, 1985. 11 Fig, 5 Tab, 14 Ref. EPA contract CR-808912.

Descriptors: *Barium, *Radium, *Cation exchange, *Water treatment, Drinking water, Groundwater treatment, Ion exchange.

The removal of barium and radium, which are found in many groundwater sources, was achieved in laboratory studies with an ion exchange process. A strong acid resin in the Ca form achieved excellent removal of Ba(2+) and Ra(2+) from water containing 15-30 mg Ba(2+)/L and 43 pCi Ra-226/L. The resin was regenerated easily with CaCl2 brine, and after repeated exhaustion-regeneration cycles using reclaimed brine, the only water quality change observed during the production cycle was the reduction of the Ba(2+) and Ra-226 concentrations. Total hardness, alkalinity, pH, and other parameters were essentially unchanged. Operation of this column in parallel with a strong acid, Na-form column will enable the production of water that meets the standards for Ba and Ra and has the hardness desired for distribution. The capacity of the virgin Ca-form column for Ba(2+) was approximately 75 mg Ba(2+)/g dry resin (H+ form) or 32 g Ba(2+)/l resin (Ca form). The capacity of the column after several exhaustion-regeneration cycles depends on the dosage of regenerant. The CaCl2 regenerant concentration of 0.85M was significantly more effective at a given dosage than higher (1.69M) or lower (0.42M) concentrations. The spent CaCl2 brine can be reclaimed for reuse. The brine reclamation process should significantly reduce the brine disposal problem, but ways of disposing of the precipitates must be found, and the cost involved in using the process must be established. (Baker-IVI)
W86-00008

**AWWA SURVEY OF INORGANIC CONTAMINANTS IN WATER SUPPLIES,**
Journal of the American Water Works Association, Vol. 77, No. 5, p 67-72, May, 1985. 12 Fig, 5 Tab.

Descriptors: *Drinking water, *Quality control, *United States, *Surveys, *Inorganic compounds, Nitrates, Sulfates, Regulations, Arsenic, Fluoride, Barium, Lead, Selenium, Cadmium, Mercury, Chromium, Silver.

Results of a survey of the United States and its territories on the frequency and extent of inorganic contaminants in drinking water supplies are reported as prepared by AWWA's Inorganic Contaminants Committee, Water Quality Division. Data are presented on the inorganic contaminants listed in the US EPA primary and secondary drinking water regulations. Thirty-nine states responded to the survey with 37 providing data. Problems with meeting the primary inorganic maximum contaminant levels (MCLs) are most common in small communities served by wells (98.4%) rather than in those served by surface water (1.6%). High nitrate concentrations were the primary reason for inactivating wells or systems that were reported to have been shut down. High fluoride was the next most frequently reported reason. Response data were scarce on systems that had been shut down. In terms of frequency only, the main difficulties in meeting the primary MCLs were a result of fluoride, nitrate and to a much lesser extent, selenium, arsenic, barium, and lead contamination. Geographic distribution patterns are clear for the occurrences of excessive nitrate, selenium, barium and arsenic. Ninety percent of the excess fluoride and nitrate-N occurrences were less than 5.0 mg/L and 20.0 mg/L, respectively. The remaining 10% still represent a significant number of water supplies. Twenty-six states responded with actual or estimated data on the secondary inorganic contaminants. If these data are linearly extrapolated for all 50 states, there are about 28,000 occurrences of contaminants in excess of the secondary MCNs. The most common secondary MCL contaminants are iron, manganese, and dissolved solids. Sulfates, chloride, and color are also quite significant. (Baker-IVI)
W86-00009

**IN-HOME TREATMENT METHODS FOR REMOVING VOLATILE ORGANIC CHEMICALS,**
Environmental Protection Agency, Cincinnati, OH. Drinking Water Research Div.
R. K. Sorrell, E. M. Daly, M. J. Weisner, and H. J. Brass.
Journal of the American Water Works Association, Vol. 77, No. 5, p 72-78, May, 1985. 6 Fig, 13 Tab, 13 Ref.

Descriptors: *Volatile compounds, *Organic compounds, *Drinking water, *Water treatment, Boiling, Electric mixing, Aeration.

The effectiveness of six in-home treatment methods for removing volatile organic chemicals (VOCs) from drinking water was investigated. At least two methods appeared excellent for temporary use in emergency situations. Boiling and electric mixing afforded about 100% removal of the test compounds (chloroform, 1,1,1-trichloroethane, carbon tetrachloride, trichloroethylene, bromoform, tetrachloroethylene, t-butyl methyl ether, benzene, ethylbenzene, m-xylene, and m-dichlorobenzene) using ordinary kitchen appliances, in phase 1. Phase 1 of the testing involved six methods - boiling, electric mixing, open standing, aeration, pouring and faucet aeration. The first four methods were reexamined in phase 2, during which VOC loss over time was monitored. Loss of VOCs by boiling was found to be variable. This variability was likely due to the lower heating efficiency of the household stove which made it difficult to determine the start of boiling. The estimated cost per month of treating water by boiling for a family of four would be about $4.70. Electric mixing provided excellent removal of VOCs in phases 1 and 2. The estimated cost to a household was about $0.30 per month using this method. A third method, open standing, provided reasonable removal without any significant compound bias. However, the length of treatment required, 48-72 hr, is excessive. Aeration was less effective and very compound dependent. While the risk of inhaling volatile organic chemicals evolved from water is basically unknown, it may be of a similar magnitude to that of ingesting water containing such chemicals, if very large volumes are being treated. This risk is also involved in such activities as cooking, showering, bathing, and using humidifiers and vaporizers. (Baker-IVI)
W86-00010

**REMOVAL BY COAGULATION OF TRACE ORGANICS FROM MISSISSIPPI RIVER WATER,**
Minnesota Univ., Minneapolis. Dept. of Civil and Mining Engineering.
M. J. Semmens, and K. Ayers.
Journal of the American Water Works Association, Vol. 77, No. 5, p 79-84, May, 1985. 15 Fig, 4 Tab, 26 Ref. EPA grant CR806377.

Descriptors: *Mississippi River, *Organic compounds, *Water treatment, *Coagulation, Salicylic acid, Acidity, Trace compounds, Octanoic acid, Phenols, Benzoic acid, Organic matter.

Studies were conducted on the removal of four truly soluble, low-molecular weight model compounds (octanoic acid, phenol, benzoic acid, and salicylic acid) by coagulation with alum and iron salts. The model compounds were generally poorly removed by coagulation. The extent of removal was weakly dependent on coagulant dosage except for salicylic acid, which showed improved removal at higher dosages in the presence of natural organics. Removal of the model organic compounds was generally better in the absence of natural organic matter. Percentage removals of the model organic compounds were similar to the removals of the <1K molecular weight fraction of the natural organic matter. The pH influenced the removal of compounds containing a phenolic-OH functional group but did not influence those containing only carboxylic acid functional groups. Coagulation removed intermediate and high molecular weight organic compounds (1-10K and 10-100K) most effectively. Removal of the model organic compounds by coagulants appeared to result from complex formation and precipitation, with the soluble metal-organic complexes formed at the low concentration (about 8 x 10 to the minus 7th power) tested limiting the extent of removal. Simple adsorption does not appear to be a significant mechanism of removal under the conditions tested. (Baker-IVI)
W86-00011

**EFFECTS ON GROUNDWATER QUALITY OF THE INTRODUCTION OF SECONDARY SEWAGE TREATMENT TO AN EFFLUENT RECHARGE SITE ON THE CHALK OF SOUTHERN ENGLAND,**
Water Research Centre, Marlow (England).
For primary bibliographic entry see Field 5D.
W86-00043

**FATE OF ALDICARB, ALDICARB SULFOXIDE, AND ALDICARB SULFONE IN FLORIDAN GROUNDWATER,**
Florida Univ., Gainesville. Dept. of Environmental Engineering Sciences.
For primary bibliographic entry see Field 5B.
W86-00045

**RAINWATER CATCHMENT WATER QUALITY IN MICRONESIA,**
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 3B.
W86-00061

**COMPARATIVE EFFECTIVENESS OF ANTIFOULING TREATMENT REGIMES USING CHLORINE OR A SLOW-RELEASING BROMINE BIOCIDE,**
Rensselaer Polytechnic Inst., Troy, NY. Dept. of Biology.
R. J. Soracco, E. W. Wilde, L. A. Mayack, and D. H. Pope.
Water Research, Vol. 19, No. 6, p 763-766, 1985. 2 Fig, 9 Ref.

Descriptors: *Fouling, *Antifouling, *Chlorine, *Biocides, *Bromine biocides, Heat exchangers, Water treatment, Cooling water, Pesticides, Industrial water.

Five chlorine (Cl2) and three slow-releasing bromine biocide (1-bromo-3-chloro-5,5-dimethylhydantoin (BCDMH)) treatment regimes were compared under laboratory conditions to determine their effectiveness in controlling the fouling of 304L stainless steel heat exchanger tubing. The most effective Cl2 treatments were low level (0.1 ppm or less) continuous applications. Three intermittent Cl2 treatments (1 h/day at 1.0 ppm, 1 h/day at 0.5 ppm, and 3 x 20 min/day at 0.5 ppm) were about equally effective. However, all three intermittent regimes were significantly less effective than the low level continuous treatments. The effectiveness of BCDMH treatment was similar to Cl2 when used intermittently at similar residual concentrations at Cl2 for 1 h/day and continuously at low levels. These experiments indicated that low level continuous treatment was more effective than intermittent treatment for controlling biofouling. (Author's abstract)
W86-00063

## Group 5F—Water Treatment and Quality Alteration

**INACTIVATION OF NAEGLERIA GRUBERI CYSTS BY CHLORINE DIOXIDE,**
Ohio State Univ., Columbus. Dept. of Civil Engineering.
Y. S. R. Chen, O. J. Sproul, and A. J. Rubin.
Water Research, Vol. 19, No. 6, p 783-789, 1985. 6 Fig, 4 Tab, 27 Ref. U.S. EPA Office of Exploratory Research grant R808150-02-0.

Descriptors: *Naegleria, *Protozoans, *Chlorine dioxide, *Water treatment, *Cysts, Hydrogen ion concentration, Water temperature, Disinfection, Ozonation, Poliovirus, Viruses.

The kinetics of chlorine dioxide inactivation of Naegleria gruberi cysts (a nonpathogenic soil and water protozoan closely related to the human parasite N. fowleri) were investigated as were the influence of pH from 5 to 9, temperature from 5 to 30 C, cyst age from 3 to 12 days, and cyst clumping. Survivals were obtained for each study as a function of time at several chlorine dioxide concentrations. Inactivation was characterized by an initial concave downward shoulder followed by an essentially linear portion but the process obeyed Watson's Law. At 25 C and pH 7 the mean concentration time product for 99% inactivation was 5.5 mg x min/l. These products varied inversely with temperature and pH. The mean concentration time product for 99% inactivation roughly doubles for each 10 C rise in the water temperature. The actual ratios were 1.6 between 5 and 15 C and 1.7 between 15 and 25 C. Ozone has the lowest time-concentration products followed in order by chlorine dioxide and chlorine. Ozone is distinctly the better disinfectant under lower temperature and at pH's of 8 or less. At a pH of 9 and at 25 C chlorine dioxide approaches ozone in effectiveness. Chlorine, at pH's above 7, rapidly loses its effectiveness as the hypochlorous acid ionizes to the hypochlorite ion. The N. gruberi cyst is distinctly more difficult to inactivate than poliovirus 1 but on the same order as bacterial spores. (Collier-IVI)
W86-00066

**OPTIMAL URBAN WATER DISTRIBUTION DESIGN,**
MacLaren Engineers, Winnipeg (Manitoba).
D. R. Morgan, and I. C. Goulter.
Water Resources Research, Vol. 21, No. 5, p 642-652, May, 1985. 7 Fig, 9 Tab, 19 Ref.

Descriptors: *Linear programming, *Water conveyance, *Hardy-Cross network solver technique, Cost analysis, Economic factors, Model studies, Optimization.

An iterative procedure capable of analyzing both layout and design of new systems and expansion of existing systems has been developed. One of the major advantages of the technique is that it ensures hydraulic consistency in each of the networks considered during the iterative procedure. In the design of new systems a wide range of loading patterns and pipe failure combinations can be considered. The manner in which the large number of constraints associated with all possible load combinations is reduced to a manageable size does not permit a claim for global optimality. The procedure must therefore be classified as heuristic. The results obtained by the procedure show that it is capable of efficiently producing economical solutions. The method has been demonstrated as being applicable to the layout and design of a network of 2 sources, 20 nodes, and 37 links, and the expansion of an existing network. Comparison of the results produced by this procedure for a network expansion problem with the results of previous studies for the same problem shows that this procedure produces an inexpensive solution in an efficient manner. The procedure is relatively simple, being based on two widely available and accepted techniques, the Hardy-Cross Network solver and linear programming operations research technique. The ability of the model to use the very efficient simplex algorithm of the linear programming makes the procedure applicable to large systems. The method also utilizes realistic and easily accessible pipe cost functions using standard cost data, i.e., cost per unit length. (Baker-IVI)
W86-00071

**CHEMISTRY FOR OPERATORS,**
Muskegon County Board, MI. Dept. of Public Works.
R. L. Fountain.
Water Treatment Plant Operation Series, Volume 4, Ann Arbor Science, Ann Arbor, MI. 1982. Edited by V. W. Langworthy. 148 p.

Descriptors: *Chemical reactions, *Reviews, *Wastewater treatment, Chlorination, Alkalinity, Coagulation, Flocculation, Phosphorus removal, Water softening, Nitrogen.

This book was written to provide the operators of water and wastewater treatment plants with a basic course in chemical theory and the chemical reactions that occur at such facilities. The first eight chapters cover basic theory and principles essential to all chemical reactions. The remaining chapters deal with chlorination, alkalinity, coagulation and flocculation, water softening, and phosphorus and nitrogen removal. Each chapter concludes with a set of problems and their solutions. The chapter on chlorination explains oxidation-reduction reactions, reactions with impurities, breakpoint chlorination, and the determination of chloride residuals. The chapter on alkalinity discusses the determination of alkalinity. The causes of turbidity and color are discussed in the chapter on coagulation and flocculation, along with the control of coagulation, the jar test, and zeta potential. The lime-soda process and the ion exchange process are considered in the chapter on water softening. In the chapter on phosphorus and nitrogen removal, nitrogen removal by biological nitrification-dentrification, breakpoint chlorination, selective ion exchange, and air stripping of ammonia is considered.
W86-00134

**HYDRAULICS FOR OPERATORS,**
Michigan Dept. of Public Health, Lansing. Section of Water Supply.
For primary bibliographic entry see Field 8B.
W86-00135

**ENVIRONMENTAL ENGINEERING,**
Duke Univ., Durham, NC. Dept. of Civil and Environmental Engineering.
P. A. Vesilind, and J. J. Peirce.
Butterworth, Boston. 1982. 602 p.

Descriptors: *Water treatment, *Wastewater treatment, *Water analysis, *Water pollution sources, *Water pollution effects, *Public health, *Sludge treatment, *Sludge disposal, Nonpoint source pollution, *Water law, Radioactive wastes, *Water supply, *Water distribution, *Sewers, Biodegradation, Wastewater characteristics, Environmental effects, Landfills.

A textbook on environmental engineering is organized in five major areas: water resources, air quality, solid and hazardous wastes, noise, and environmental impact. Water-related topics include water pollution, measurement of water quality, water supply and transmission, water treatment methods, wastewater collection and treatment, sludge treatment and disposal, nonpoint source water pollution and its control, water pollution law, landfills, and environmental impact and assessment.
W86-00188

## 5G. Water Quality Control

**SEAWATER CIRCULATION IN SEWAGE OUTFALL TUNNELS,**
New South Wales Univ., Kensington (Australia). Water Research Lab.
For primary bibliographic entry see Field 5E.
W86-00017

**HYPOLIMNETIC AERATION: PRACTICAL DESIGN AND APPLICATION,**
British Columbia Ministry of Environment, Vancouver. Fisheries Research and Technical Services Section.
K. I. Ashley.
Water Research, Vol. 19, No. 6, p 735-740, 1985. 23 Ref, 1 Append. NRC grant 67-3454.

Descriptors: *Aeration, *Hypolimnetic aeration, *Lake restoration, *Fisheries managment, Destratification, Design criteria, Oxygenation.

Hypolimnetic aeration is becoming increasingly important as a fisheries management and water quality improvement technique, however its application has been restricted by a paucity of practical reference material. Hypolimnetic aeration includes partial and full lift designs and several air/oxygen injection systems. Positive displacement compressors flanged to three phase electric motors are the preferred air supply and power for most lake aeration projects. Internal combustion power is adequate for short term use and wind power is in the developmental stage. Rubber compressed air hose is recommended for lake aeration applications. Free air delivery is the air volume taken into the compressor at standard temperature and pressure however actual output volume is regulated by discharge pressure. Performance specifications of full lift hypolimnetic aerators are based on water:air ratios, oxygen increase, transfer efficiencies and oxygenation capacity. An empirical sizing method was developed using hypolimnetic volume, hypolimnetic oxygen consumption, water flow, air flow and inflow tube radius. Outflow tube radius should equal or exceed inflow tube radius to achieve high flow rates and allow efficient removal of residual bubbles. Floatation requirements were calculated from the total weight of the separator box, inflow and outflow tubes and the theoretical water head. (Author's abstract)
W86-00060

**RELEASE OF ENDOTHALL FROM AQUATHOL GRANULAR AQUATIC HERBICIDE,**
North Texas State Univ., Denton. Dept. of Biological Sciences.
K. H. Reinert, S. Stewart, M. L. Hinman, J. H. Rogers, Jr., and T. H. Leslie.
Water Research, Vol. 19, No. 6, p 805-808, 1985. 3 Fig, 3 Tab, 21 Ref.

Descriptors: *Herbicides, *Fate of pollutants, *Endothall, *Aquatic plants, *Pesticide kinetics, Kinetics, Fish, Sunfish, Water pollution effects.

The release rate kinetics of endothall from Aquathol Granular Aquatic Herbicide (Aquathol) were determined in two static shake flask tests and the release half-life was determined from the release rate. A zero-order release rate of 1.58 mg/l/h and a half-life of 5.06 h were calculated from the replicate studies. These experiments show that Aquathol releases endothall relatively rapidly in a static environment; however, this release would be expected to be faster in a dynamic aquatic system such as a reservoir where horizontal dispersion and dilution can occur. The release rate, when coupled with the fate processes affecting endothall persistence in aqueous systems and the relatively high endothall concentration required for acute toxicity to non-target organisms such as bluegill sunfish (428 mg/l), make Aquathol a candidate for control of nuisance aquatic vegetation where water usages are critical. (Collier-IVI)
W86-00068

**APPLICATION OF THE STORM MODEL TO DESIGN PROBLEMS IN SINGAPORE AND IN KAOSIUNG, REPUBLIC OF CHINA,**
Camp, Dresser and McKee, Inc., Boston, MA.
For primary bibliographic entry see Field 6A.
W86-00086

**MIXING ZONE MODEL FOR CONSERVATIVE PARAMETERS,**
Oklahoma Water Resources Board, Oklahoma City.
M. R. Hutcheson.
In: Proceedings of Stormwater and Water Quality Model User Group Meeting, January 27-28, 1983, University of Florida, Gainesville. p 65-86, 11 Fig, 1 Tab, 12 Ref.

Descriptors: *Model studies, *Waste load, *Mixing, Water quality, *Water quality management, *Mathematical studies, *Water quality standards, *Numerical analysis, Models, Nonpoint pollution sources, Wastewater disposal, Water quality control, Industrial wastes.

The development of a wasteload allocation process which incorporates a numerical solution to the dispersion equation is described. The methodology relies on simplification of the dispersion equation through the use of assumptions so that it may be solved numerically. Then a relationship between the standard deviation of a Gaussian distribution and the dispersion coefficient is derived. A relationship for the standard deviation, hence the dispersion coefficient is developed based on hydrology and plume dimensions. The dispersion equation is solved numerically for pollutant concentration at grid points throughout the mixing zone. The maximum concentration at the end of the mixing zone, the related source strength, the background concentration and the water quality standard are used to determine the wasteload allocation which will protect the water quality standard. This process is applicable to multiple discharges as well as isolated ones, using the superposition principle. The methodology was applied to an industrial point source (Farmland Industries) that discharges into Skeleton Creek. It was demonstrated that the dispersion model can predict concentration distributions well enough to develop permit limits which will allow water quality standards in a receiving stream to be met.
W86-00089

**SOME RECENT ADAPTATIONS AND APPLICATIONS OF QUAL-II IN THE NORTHEAST,**
For primary bibliographic entry see Field 5B.
W86-00090

**REVIEW OF MODEL USE IN EVALUATING NONPOINT SOURCE LOADS FROM FOREST MANAGEMENT ACTIVITIES,**
National Council of the Paper Industry for Air and Stream Improvement Inc., New York.
For primary bibliographic entry see Field 5B.
W86-00091

**MECHANISTIC SIMULATION FOR TRANSPORT OF NONPOINT SOURCE POLLUTANTS,**
Simons, Li and Associates, Inc., Fort Collins, CO.
For primary bibliographic entry see Field 5B.
W86-00092

**PLANNING AND IMPLEMENTATION OF REGIONAL STORMWATER MANAGEMENT FACILITIES IN MONTGOMERY COUNTY, MARYLAND,**
Greenhorne and O'Mara, Inc., Riverdale, MD.
For primary bibliographic entry see Field 4A.
W86-00099

**NUTRIENT INPUT FROM THE LOXAHATCHEE RIVER ENVIRONMENTAL CONTROL DISTRICT SEWAGE-TREATMENT PLANT TO THE LOXAHATCHEE RIVER ESTUARY, SOUTHEASTERN FLORIDA,**
Geological Survey, Tallahassee, FL. Water Resources Div.
For primary bibliographic entry see Field 5B.
W86-00110

**NATIONAL WATER SUMMARY 1983--HYDROLOGIC EVENTS AND ISSUES.**
Geological Survey, Reston, VA. Water Resources Div.
For primary bibliographic entry see Field 6B.
W86-00131

**ECONOMIC PERSPECTIVES ON ACID DEPOSITION CONTROL.**
Acid Precipitation Series, Volume 8, Butterworth Publishers, Boston, 1984. Volume edited by Thomas D. Crocker. Series edited by John I. Teasley. 180 p.

Descriptors: *Water quality control, *Acid rain, *Air pollution, Precipitation, *Economic aspects, Policy making, Fate of pollutants, Fisheries, Decision making, Cost analysis, Model studies, Legal aspects, Canada.

Papers on the economic aspects of acid aspects of acid deposition control are grouped into five general topics: (1) policy perspectives (the current level of scientific knowledge relative to possible control decisions), (2) economic benefits of control (dose-response estimation, economic damages to the Adirondack fisheries, and economic damages from a Canadian perspective), (3) international aspects (legal, economic, and political aspects of transfrontier pollution), (4) economically optimal control strategies, and (5) economic caveats.
W86-00136

**ACID RAIN: DOES SCIENCE DICTATE POLICY OR POLICY DICTATE SCIENCE,**
Georgia Univ., Athens. Inst. of Natural Resources.
For primary bibliographic entry see Field 6E.
W86-00137

**EFFECT OF GLOBAL OPTIMIZATION ON LOCALLY OPTIMAL POLLUTION CONTROL: ACID RAIN,**
West Virginia Univ., Morgantown. Dept. of Economics.
For primary bibliographic entry see Field 6C.
W86-00138

**ECONOMICALLY RELEVANT RESPONSE ESTIMATION AND THE VALUE OF INFORMATION: ACID DEPOSITION,**
Oregon State Univ., Corvallis. Dept. of Agricultural Economics.
For primary bibliographic entry see Field 6B.
W86-00139

**SCIENTIFIC TRUTHS AND POLICY TRUTHS IN ACID DEPOSITION RESEARCH,**
Wyoming Univ., Laramie. Dept. of Economics.
For primary bibliographic entry see Field 6B.
W86-00140

**NORMATIVE ECONOMICS AND THE ACID RAIN PROBLEM,**
Oklahoma Univ., Norman. Div. of Economics.
For primary bibliographic entry see Field 6B.
W86-00141

**ECONOMIC IMPACT OF ACID PRECIPITATION: A CANADIAN PERSPECTIVE,**
Oklahoma Univ., Norman. Div. of Economics.
For primary bibliographic entry see Field 6C.
W86-00142

**LEGAL, ETHICAL, ECONOMIC AND POLITICAL ASPECTS OF TRANSFRONTIER POLLUTION,**
Resources for the Future, Inc., Washington, DC.
For primary bibliographic entry see Field 6E.
W86-00143

**ACIDIFICATION IMPACT ON FISHERIES: SUBSTITUTION AND THE VALUATION OF RECREATION RESOURCES,**
Clarkson Univ., Potsdam, NY. Dept. of Economics.
F. C. Menz, and J. K. Mullen.
IN: Acid Precipitation Series, Volume 8: Economic Perspectives on Acid Deposition Control, Butterworth Publishers, Boston. 1984. Volume edited by Thomas D. Crocker. Series edited by John I. Teasley. p 135-155, 3 Fig, 6 Tab, 44 Ref.

Descriptors: *Water pollution effects, *Cost analysis, *Acid rain, *Fisheries, Precipitation, Air pollution, Economic aspects, Adirondack Mountains, New York, Lake fisheries, Stream fisheries, Recreation, Model studies.

Economic losses to anglers in the Adirondack recreational fishery resulting from acidification damage were estimated at $1.7-3.2 million, depending on assumptions pertaining to habitat loss and substitution by anglers among fisheries. These were considered lower-bound estimates for the following reasons: (1) estimates were based only on licensed New York resident anglers fishing in waters open to public fishing, (2) they were based on the assumption that information concerning the effect of acidification on alternative fishing sites is known and accurately perceived by the angling population, (3) estimates of currently perceived damages may understate future damages if acidification is irreversible, and (4) results of this study pertained only to the currently observable effects of acidification on a limited portion of the Adirondack recreational fishery.
W86-00144

**TRANSFERABLE DISCHARGE PERMITS AND PROFIT-MAXIMIZING BEHAVIOR,**
Wyoming Univ., Laramie. Dept. of Economics.
J. T. Tschirhart.
IN: Acid Precipitation Series, Volume 8: Economic Perspectives on Acid Deposition Control, Butterworth Publishers, Boston. 1984. Volume edited by Thomas D. Crocker. Series edited by John I. Teasley. p 157-171, 3 Fig, 14 Ref, 1 Append.

Descriptors: *Water quality control, *Acid rain, *Air pollution, Water pollution control, Permits, Economic aspects, Transferable discharge permits, Precipitation, Profit, Regulations.

A model of a profit-maximizing firm was presented where the firm confronts an emission standard and has the options to either install scrubbers or enter into transferable discharge permit (TDP) markets. The results of the model characterize how the firm chooses among the options to meet the standard at minimum cost. However, the driving force behind the minimum cost solution is that the firm is a profit maximizer. There are situations where this may not be an appropriate assumption. For instance, in regulated industries where constraints on profits are invoked by government commissions, the minimum cost solution is not attained. A bias toward overutilization of scrubbers is possible. Even in nonregulated industries, however, there are plausible reasons why firms do not maximize profit, including uncertainty, organization complexity and alternative goals. All of this is not to say that TDP markets should be abandoned. Instead, this chapter contains a number of pitfalls that regulators should be aware of when implementing TDP markets. How important these pitfalls are is an empirical question that cannot be answered until the market are allowed to operate for some time. Until then, control agencies should closely observe those firms that may be candidates for these pitfalls, particularly those in regulated industries. And if their behavior deviated from that outlined above, adjustments in the TDP system are in order. (Author)
W86-00145

**TECHNIQUES TO REDUCE THE SEDIMENT RESUSPENSION CAUSED BY DREDGING,**
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
G. L. Raymond.
Miscellaneous Paper HL-84-3, September 1984. Final Report. 33 p, 14 Fig, 15 Ref.

Descriptors: *Suspended solids, *Dredging, *Suspended sediments, *Ecological effects, Bottom sediments, Dredges, Turbidity, Reviews, Fluvial sediments, Marine sediments, Design criteria, Polychlorinated biphenyls, Water resources development, Channel improvement.

As part of a larger effort under the Improvement of Operation and Maintenance Techniques Program to develop a method to predict the extent of sediment resuspension and contaminant release when dredging in contaminated sediments, the U. S. Army Engineer Waterways Experiment Station's Water Resources Engineering Group is conducting field studies to evaluate new and existing

dredging methods. The level of sediment resuspended by a given dredge type in a given sediment was examined using various operational parameters. Results of the first 2 yr of study which included field work and extensive literature reviews show that different dredge types produce different amounts of suspended sediment in different parts of the water column. Resuspensions caused by cutterhead and hopper dredges tend to remain in the lower water column, while bucket dredges increase resuspensions throughout the water columns. The amount of resuspension caused by a given dredge type also depends on the operating techniques used with the dredge. Sediment resuspension can be lessened by changing operating techniques, as in the case of the cutterhead, or by modifying the equipment, such as enclosing a clamshell bucket. Special purpose dredges can also be used to reduce sediment resuspension, but their lower production rates limit their application.
W86-00159

**POTENTIAL FOR CONTAMINATION OF SHALLOW AQUIFERS IN ILLINOIS,**
Illinois State Geological Survey Div., Champaign.
For primary bibliographic entry see Field 5E.
W86-00178

**SORPTION BEHAVIOUR OF 14C IN GROUNDWATER/ROCK AND IN GROUNDWATER/CONCRETE ENVIRONMENTS,**
Seakem Oceanography Ltd., Sidney (British Columbia).
For primary bibliographic entry see Field 5B.
W86-00184

**OIL SHALE MINING, PROCESSING, USES, AND ENVIRONMENTAL IMPACTS, 1978-JULY, 1981: CITATIONS FROM THE NTIS DATA BASE.**
National Technical Information Service, Springfield, VA.
For primary bibliographic entry see Field 4C.
W86-00201

**DEVELOPMENT DOCUMENT FOR EFFLUENT LIMITATIONS GUIDELINES AND STANDARDS FOR THE TEXTILE MILLS POINT SOURCE CATEGORY.**
Environmental Protection Agency, Washington, DC. Effluent Guidelines Div.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-116871. EPA 440/1-82/022, September 1982. Final Report. 509 p, 11 Fig, 152 Tab, 238 Ref, 1 Append.

Descriptors: *Water quality control, *Wastewater treatment, *Textile mill wastes, *Industrial wastes, *Standards, *Effluent limitations, *Water pollution sources, *Wastewater composition, Water pollution control, Water use, Water reuse, Water conservation, Conservation, Chemical wastes, Wool, Biological wastewater treatment, Process control.

Textile manufacturing facilities were studied to develop effluent limitations for existing point sources, standards of performance for new sources, and pretreatment standards for existing and new sources. The industry was divided into several subcategories: wool scouring, wool finishing, low water use processing, woven fabric finishing, knit fabric finishing, carpet finishing, stock and yarn finishing, nonwoven manufacturing, and felted fabric processing. Raw wastewater characteristics vary widely among the categories and also within each category, depending on raw materials and process control. Of 123 toxic pollutants, only 22 were not present or suspected to be present in textile mill wastewaters. Data are listed for analyses of toxic pollutants in the water supply and in treated effluents. The following wastewater constituents were designated as subject to limitation under BPT, BAT and NSPS as appropriate: BOD, total suspended solids, pH, total chromium, COD, phenols, and sulfide. In-plant controls and process changes suitable for pollution control include water reuse, water use reduction, chemical substitution, and material reclamation. Available wastewater treatment technologies are described in detail.
W86-00207

**OIL SHALE MINING, PROCESSING, USES, AND ENVIRONMENTAL IMPACTS, AUGUST, 1981-OCTOBER, 1982: CITATIONS FROM THE NTIS DATA BASE.**
National Technical Information Service, Springfield, VA.
For primary bibliographic entry see Field 5D.
W86-00215

**RESTORATION OF HABITATS IMPACTED BY OIL SPILLS.**
For primary bibliographic entry see Field 5C.
W86-00239

**RECOVERY AND RESTORATION OF ROCKY SHORES, SANDY BEACHES, TIDAL FLATS, AND SHALLOW SUBTIDAL BOTTOMS IMPACTED BY OIL SPILLS,**
Stockholm Univ. (Sweden). Dept. of Zoology.
For primary bibliographic entry see Field 5C.
W86-00240

**EFFECTS OF OIL ON SEAGRASS ECOSYSTEMS,**
Virginia Univ., Charlottesville. Dept. of Environmental Sciences.
For primary bibliographic entry see Field 5C.
W86-00241

**RECOVERY AND RESTORATION OF SALT MARSHES AND MANGROVES FOLLOWING AN OIL SPILL,**
Research Planning Inst., Inc., Columbia, SC.
For primary bibliographic entry see Field 5C.
W86-00242

**MEASUREMENTS OF DAMAGE, RECOVERY, AND REHABILITATION OF CORAL REEFS EXPOSED TO OIL,**
Continental Shelf Associates, Inc., Boulder, CO.
For primary bibliographic entry see Field 5C.
W86-00243

**FISHERIES RESOURCE IMPACTS FROM SPILLS OF OIL OR HAZARDOUS SUBSTANCES,**
Environmental Research Lab., Gulf Breeze, FL.
For primary bibliographic entry see Field 5C.
W86-00244

**LEACHATE FROM HAZARDOUS WASTES SITES,**
New Jersey Inst. of Tech., Newark. Dept. of Civil and Environmental Engineering.
For primary bibliographic entry see Field 5B.
W86-00247

**PLANNING GUIDE FOR EVALUATING AGRICULTURAL NONPOINT SOURCE WATER QUALITY CONTROLS,**
Cornell Univ., Ithaca, NY.
P. D. Robillard, M. F. Walter, and L. M. Bruckner.
EPA-600/3-82-021, September 1982. Environmental Research Laboratory, Athens, GA. 733 p, 33 Fig, 22 Tab, 23 Refs, 6 Append. Contract/Grant No. R804925010.

Descriptors: *Water quality control, *Water pollution sources, *Fate of pollutants, *Agriculture, *Nonpoint pollution sources, Planning, Pollution load, Nitrogen, Phosphorus, Sediment, Animal wastes, Salinity, Nutrients, Farm management, Farm wastes, Insecticides, Pesticides, Fertilizers, Irrigation, Eutrophication, Soil conservation, Sediment transport, Erosion control, Cover crops, Terracing, Economic aspects, Honey Creek, Ohio, Yakima River, Washington, Cornell Nutrient Simulation Model, Model studies.

This is a manual for evaluation and selection of agricultural nonpoint source controls for irrigated and nonirrigated cropland. The methodology applies to areas ranging in size from an individual farm to a large region. Agricultural practices and their impacts on water quality are described. Pollutants of concern are nitrogen, phosphorus, sediment, animal wastes, and salinity. Pollution control measures involving tillage methods, cropping practices, and methods of fertilizer and pesticide application are divided into three groups: structural, vegetative, and managerial. The evaluation methodology consists of several steps: (1) description of the watershed, (2) identification of the problem, (3) determination of applicable control measures, (4) choice of the unit of analysis, (5) establishment of the base condition, (6) evaluation of control measures, and (7) development of an optimal control strategy. The methodology is demonstrated with two examples: an individual farm in the Yakima River basin, Washington, and the Honey Creek, Ohio, watershed. The six appendixes, comprising 600 pages of the manual, concern sediment and nutrient loadings from nonirrigated croplands, sediment and nutrient loss from irrigated agriculture, salinity control, water quality problems related to animal agriculture, insecticide use, and economic perspectives of nonpoint source water quality management.
W86-00260

**WINTER EVALUATION OF OIL SKIMMERS AND BOOMS.**
Environmental Protection Service, Ottawa (Ontario).
Report EPS 4-EP-84-1, February 1984. 109 p, 39 Fig, 17 Tab, 7 Ref, 3 Append.

Descriptors: *Water quality control, *Water pollution control, *Oil recovery, *Cleanup, Oil skimmers, Booms, Oil spills, Little Giant, Destroil, Slicklicker, Skim-Pak, Morris MI-80, Arctic Skimmer, Arctic Marine Oilspill Program, Zoom Boom, Albany Oilfence, Troilboom, Vikoma Seapack, Cold regions.

Five mechanical oil recovery devices (skimmers) and six oil containment barriers were evaluated in Newfoundland and Nova Scotia during March-April 1980. The skimmers varied in size, collection principle, and intended application. Specific comments were given for each. However, some general conclusions were drawn. Only the Destroil and Versatech Arctic Skimmer were deemed capable of surviving moderate sea conditions. Although they can recover a wide range of oils, they would have difficult processing cold Bunker C directly from the water's surface. The Skim-Pak was considered useful for crude oil or low viscosity products in calm water. The Slicklicker, as a shore-mounted unit, was judged useful for handling Bunker C and solids. Little Giant showed promise as a Bunker C recovery device. The Morris MI-80, as presently designed, proved to be too complicated. The U.S. Coast Guard boom proved durable, well designed, and of high quality construction. The AMOP and Zoom booms effectively contained oil; the length of the lower tension member was an important factor. All booms tested were strong enough and durable enough to handle realistic loads.
W86-00290

**EUROPEAN AND UNITED STATES CASE STUDIES IN APPLICATION OF THE CREAMS MODEL.**
International Inst. for Applied Systems Analysis, Laxenburg (Austria).
For primary bibliographic entry see Field 5B.
W86-00294

**CREAMS: A SYSTEM FOR EVALUATING MANAGEMENT PRACTICES ON FIELD-SIZE AREAS,**
Agricultural Research Service, Tifton, GA. Southeast Watershed Research Center.
For primary bibliographic entry see Field 5B.
W86-00295

TESTING THE APPLICATION OF CREAMS TO FINNISH CONDITIONS,
National Board of Waters, Helsinki (Finland).
For primary bibliographic entry see Field 5B.
W86-00296

ENVIRONMENTAL EFFECTS OF NITROGEN FERTILIZATION EXEMPLIFIED BY GROUNDWATER POLLUTION AS SIMULATED BY CREAMS,
Goettingen Univ. (Germany, F.R.).
For primary bibliographic entry see Field 5B.
W86-00297

APPLICATION OF THE CREAMS MODEL FOR CALCULATION OF LEACHING OF NITRATE FROM LIGHT SOILS IN THE NOTEC RIVER VALLEY,
Institute for Land Reclamation and Grassland Farming, Raszyn (Poland).
For primary bibliographic entry see Field 5B.
W86-00298

APPLICATION OF THE CREAMS MODEL: WESTERN SKANE, SWEDEN,
Lund Univ. (Sweden). Dept. of Water Resources Engineering.
For primary bibliographic entry see Field 5B.
W86-00299

PREDICTING HILLSLOPE RUNOFF AND EROSION IN THE UNITED KINGDOM: PRELIMINARY TRIALS WITH THE CREAMS MODEL,
National Coll. of Agricultural Engineering, Silsoe (England).
For primary bibliographic entry see Field 5B.
W86-00300

APPLICATION OF THE CREAMS MODEL AS PART OF AN OVERALL SYSTEM FOR OPTIMIZING ENVIRONMENTAL MANAGEMENT IN LITHUANIA, USSR: FIRST EXPERIMENTS,
Lithuanian Research Inst. of Forestry, Vilnius (USSR).
For primary bibliographic entry see Field 5B.
W86-00301

REVIEW OF CASE STUDIES OF CREAMS MODEL APPLICATION,
Agricultural Research Service, Tifton, GA. Southeast Watershed Research Center.
For primary bibliographic entry see Field 5B.
W86-00302

# 6. WATER RESOURCES PLANNING

## 6A. Techniques Of Planning

DYNAMIC MODEL FOR MULTIRESERVOIR OPERATION,
California Univ., Davis. Dept. of Land, Air and Water Resources.
M. A. Marino, and H. A. Loaiciga.
Water Resources Research, Vol. 21, No. 5, p 619-630, May, 1985. 8 Fig, 5 Tab, 29 Ref. University of California, Water Resources Center project UCAL-WRC-W-634.

Descriptors: *Model studies, *Reservoir operation, *Operating policies, *Central Valley Project, *California, Planning, Management planning, Hydroelectric power, Electric power production.

A methodology to obtain optimal reservoir operation policies for a large-scale reservoir system was developed. The model yields medium-term (one-year-ahead) optimal release policies that allow the planning of activities within the current water year, with the possibility of updating preplanned activities to account for uncertain events that affect the state of the system. River flows are characterized as a multivariate autoregressive process and are forecasted using maximum likelihood estimators. The solution method is a sequential dynamic decomposition algorithm that keeps computational requirements and dimensionality problems at low levels. The model maximizes the system annual energy generation while satisfying constraints imposed on the operation of the reservoir network. Several alternative versions of the model can be used under different assumptions. The model was applied to a large-scale multireservoir system, the northern portion of the California Central Valley Project. The optimal release policies show a potential increase in the system total annual energy with respect to heuristic schedules currently in use. (Author's abstract)
W86-00069

QUADRATIC MODEL FOR RESERVOIR MANAGEMENT: APPLICATION TO THE CENTRAL VALLEY PROJECT,
California Univ., Davis. Dept. of Land, Air and Water Resources.
M. A. Marino, and H. A. Loaiciga.
Water Resources Research, Vol. 21, No. 5, p 631-641, May, 1985. 4 Fig, 3 Tab, 6 Ref.

Descriptors: *Reservoir operation, *Central Valley Project, *California, *Model studies, *Quadratic models, Optimization, Planning, Water management, Reservoir releases, Hydroelectric power.

A quadratic optimization model is applied to the Central Valley Project in California to obtain operation schedules. The model has the minimum possible dimensionality, treates spillage and penstock releases as decision variables and takes advantage of system-dependent features to reduce the size of the decision space. The quadratic optimization model was compared with a linear model. Both models lead to a potential increase in the annual energy production, as was demonstrated for a water year of average streamflow conditions. The quadratic model showed that the Sacramento-San Joaquin Valley agricultural water deliveries can be increased by adopting the optimal release policies. This suggests the possibility of expanding irrigated areas, providing better leaching of agricultural fields, and improving conjunctive management of agricultural fields, and improving conjunctive management of surface and groundwater reservoirs. Although the release policies computed by the quadratic and linear models were similar, there are reasons for preferring the quadratic model. First, it leads to problems of lower dimensionality and provides a closer representation of the physical features of the system, particularly with regard to nonlinearities in the objective function and constraints. Second, because of its capability to incorporate spillages explicitly, the quadratic model can handle a reservoir system of more complicated configuration and complex mass balance equation. (Baker-IVI)
W86-00070

APPLICATION OF THE STORM MODEL TO DESIGN PROBLEMS IN SINGAPORE AND IN KAOSIUNG, REPUBLIC OF CHINA,
Camp, Dresser and McKee, Inc., Boston, MA.
B. M. Harley.
In: Proceedings of Stormwater and Water Quality Model Users Group Meeting, January 27-28, 1983, University of Florida, Gainesville. p 22-42, 11 Fig.

Descriptors: *Model studies, *Project planning, *Design criteria, *Urban runoff, *Developing countries, *Water supply development, *Sewer systems, Storm runoff, Hydrologic models, Simulation analysis, Wastewater treatment.

Two examples of the application of modified versions of the STORM model are presented. The first application involved a study in Singapore where urban stormwater runoff was to be captured and treated to augment the island's water supply. The STORM model was used to evaluate the basin runoff, to size the diversion/storage/pumping facilities, and to help determine the effective safe yield from the proposed project. The STORM model also enabled the design team to evaluate the effectiveness of the many quantity and quality control options which should be considered during project development. The second application of the STORM model was in the development of design strategies to control heavily contaminated combined sewer overflows to the Jen Ai River of Kaohsiung, Republic of China. The design study was for a series of major combined sewer overflow structures which, in conjunction with a single trunk sewer, will reduce BOD loadings on the river by over 90%. Use was made of the model's ability to simulate the effect of storage and local treatment at each of the control facilities. These two examples demonstrate that models such as STORM can be effectively used in design situations in developing countries.
W86-00086

ATTEMPT TO IMPLEMENT SWMM IN TUNISIA,
Lund Univ. (Sweden).
J. Niemczynowicz.
In: Proceedings of Stormwater and Water Quality Model User Group Meeting, January 27-28, 1983, University of Florida, Gainesville. p 43-52, 7 Fig, 5 Ref.

Descriptors: *Model studies, *Rainfall-runoff relationships, *Hydrologic models, *Urban runoff, *Storm runoff, *Storm water, *Computer models, *Hydrographs, Runoff, Storm sewers, Management planning, Urban hydrology.

To aid the city of Tunis in stormwater management, a cooperative project was undertaken by the Universities of Lund and Tunis to apply the Storm Water Management Model (SWMM) to the city's problems. The project also sought to teach local research personnel how to handle the model. In order to obtain input data for model calibration, rainfall and runoff data from the Guereb-Roriche catchment which covers about 20 sq km, was used. Significant differences between Swedish and Tunisian urban areas coupled with climatic differences caused significant differences in the input parameters of the model. Also a lack of understanding of the 'modeling philosophy' and a lack of trained hydrologists who knew how to run the computer further complicated the use of the SWMM. Despite these problems, it was possible to reproduce the observed hydrographs quite well as long as the areal distribution of rainfall was taken into account.
W86-00087

MODELING WATER DEMANDS.
For primary bibliographic entry see Field 6D.
W86-00270

## 6B. Evaluation Process

CONDENSED DISAGGREGATION MODEL FOR INCORPORATING PARAMETER UNCERTAINTY INTO MOUTHLY RESERVOIR SIMULATIONS,
Cornell Univ., Ithaca, NY. Dept. of Environmental Engineering.
For primary bibliographic entry see Field 2E.
W86-00073

NATIONAL WATER SUMMARY 1983--HYDROLOGIC EVENTS AND ISSUES.
Geological Survey, Reston, VA. Water Resources Div.
Available from Supt. of Documents, GPO, Washington, D.C. 20402. USGS Water-Supply Paper 2250, 1984. 243 p, 26 Fig, 9 Tab.

Descriptors: *National water assessment, *United States, *State water issues, *Hydrologic events, Water availability, Water quality, Hydrologic hazards, Land use, Institutional arrangements, Water management.

This national summary reviews current hydrologic conditions and recent events in the United States and provides a broad overview of the hydrologic issues facing the Nation. The summary also includes a description of water issues for each State, the District of Columbia, Puerto Rico, the U.S.

Virgin Islands, and the Western Pacific Islands under the jurisdiction of the United States. The State water-issue summaries were prepared by U.S. Geological Survey personnel in each of the States and are based on discussions with more than 130 State and local organizations. Taken together, these State summaries indicate the major similarities and differences in water issues facing different parts of the country. Major issues described include (1) the short-term vulnerability of surface-water supplies and shallow ground-water supplies to drought; (2) concerns about the reliability of water supplies as competition for water increases; (3) declining ground-water levels; (4) control of surface-water pollution, especially nonpoint sources of pollution; (5) contamination of ground-water supplies and the mitigation of existing sources of pollution, such as hazardous-waste sites; (6) the potential effects of acidic precipitation; (7) chronic problems of flooding; (8) the impacts of resource development, such as coal mining and low-head hydropower, on water resources; and (9) the development of water allocation and reallocation procedures. Hydrologic perspectives on these issues are discussed under the headings 'Water availability'; Water quality'; 'Hydrologic hazards and land use'; and 'Institutional and management'. (USGS)
W86-00131

ECONOMIC PERSPECTIVES ON ACID DEPOSITION CONTROL.
For primary bibliographic entry see Field 5G.
W86-00136

ECONOMICALLY RELEVANT RESPONSE ESTIMATION AND THE VALUE OF INFORMATION: ACID DEPOSITION,
Oregon State Univ., Corvallis. Dept. of Agricultural Economics.
R. M. Adams, and T. D. Crocker.
IN: Acid Precipitation Series, Volume 8: Economic Perspectives on Acid Deposition Control, Butterworth Publishers, Boston. 1984. Volume edited by Thomas D. Crocker. Series edited by John I. Teasley. p 35-64, 5 Tab, 37 Ref.

Descriptors: *Cost analysis, *Acid rain, *Air pollution, *Water pollution effects, Precipitation, Economic aspects, Model studies, Mathematical models, Water pollution control, Sulfur oxides, Agriculture, Decision making, Policy making, Regulations, Water quality control.

The response of ecosystems to acid deposition and the applicability of such response measures to economic assessments were reviewed, and a decision theoretic framework was developed. The methods were applied to an agricultural problem using corn, soybeans, and cotton as examples. A numerical example compared four increasingly stringent regulatory policies from no standard (ambient oxidant standard of 0.18 ppm) to 0.08 ppm. Results were considered highly conditional. Any similar empirical assessment of response estimates would benefit from more comprehensive treatment of the economics of commodity demand and supply and better cost data, as well as a more complete statement of the decison making process of regulatory entities.
W86-00139

SCIENTIFIC TRUTHS AND POLICY TRUTHS IN ACID DEPOSITION RESEARCH,
Wyoming Univ., Laramie. Dept. of Economics.
T. D. Crocker.
IN: Acid Precipitation Series, Volume 8: Economic Perspectives on Acid Deposition Control, Butterworth Publishers, Boston. 1984. Volume edited by Thomas D. Crocker. Series edited by John I. Teasley. p 65-79, 36 Ref.

Descriptors: *Cost analysis, *Acid rain, *Air pollution, Precipitation, *Water quality control, Economic aspects, Social aspects, Policy making.

The tradeoff of one set of socially nonoptimal biases in emitter and receptor behavior against another set implies that the total social costs of acid depositions may be nonmonotonic in the combination of the receptors' share of a realized environmental impact and in the critical values policymakers and researchers use to reject or to fail to reject hypotheses about cause-effect of source-cause linkages. For example, if emitters know they will be made responsible for only a minor portion of the cost consequences of a realized enviromental impact, a relatively coarse test for failing to reject either of the aforementioned linkages may have less total social cost than does a more discriminating test; the lesser emitter responsibility generates fewer emitter costs, while the less stringent critical values favor receptors. All this presumes that emitters and receptors perceive their interactions with the policymaker as being contingent on less-than-complete policymaker knowledge of cause-effect and source-cause linkages. The policymaker's choices of target levels for environmental response and emission controls, and the receptors' share directly influence emitter and receptor incentives and thus the total social costs of their activities. In a stochastic world in which emitters do not have to bear the full cost consequences of their activities, scientifically less-than-ideal hypothesis test procedures can desirably alter emitter and receptor investment incentives. Very lenient criteria for failing to reject the results on environmental impacts embodied in scientific reports can reduce the total social costs of acid deposition and their control. This result in no way depends on costly information acquisition for control costs or environmental impacts.
W86-00140

NORMATIVE ECONOMICS AND THE ACID RAIN PROBLEM,
Oklahoma Univ., Norman. Div. of Economics.
L. S. Eubanks, and R. A. Cabe.
IN: Acid Precipitation Series, Volume 8: Economic Perspectives on Acid Deposition Control, Butterworth Publishers, Boston. 1984. Volume edited by Thomas D. Crocker. Series edited by John I. Teasley. p 81-96, 17 Ref.

Descriptors: *Cost analysis, *Acid rain, *Air pollution, Precipitation, Economic aspects, Water pollution control, Decision making, Policy, Water quality control, *Normative economics, Alternative planning, Planning, Legal aspects, Philosophy.

The scope of normative economics is limited in a way that excludes arguments that favor or oppose specific criteria for judging optimality. Politicians and philosophers are regarded to have expertise to make such arguments. It is unfortunate that standard practice of normative economics is almost exclusively associated with the study of only one criterion, the efficiency criterion. The implication of this is that normative economics as practiced has a very limited normative basis. This conclusion is illustrated clearly when a number of contributions to the philosophy literature are examined. It is not suggested that normative economics is of little use in policymaking, only that the self-delimited scope of normative economics should be understood in its proper perspective. The practice of normative economics has not been entirely true to its traditional definition because it is seldom interested in the study of criteria posing as alternatives to the criterion of efficiency. Certainly there is an enormous amount of interesting normative economic analysis, as traditionally defined, concerning alternative normative criteria. Normative economic analysis certainly has relevance to policymaking with respect to environmental problems such as acid rain, but perhaps only if it remains true to its defined scope and allocates its effort to the analysis of a much larger set of criteria for evaluating desirable resource uses. (Author)
W86-00141

## 6C. Cost Allocation, Cost Sharing, Pricing/Repayment

WATER UTILITY OPERATING DATA: AN ANALYSIS,
Ames, IA.
For primary bibliographic entry see Field 6D.
W86-00004

EFFECT OF GLOBAL OPTIMIZATION ON LOCALLY OPTIMAL POLLUTION CONTROL: ACID RAIN,
West Virginia Univ., Morgantown. Dept. of Economics.
S. Atkinson.
IN: Acid Precipitation Series, Volume 8: Economic Perspectives on Acid Deposition Control, Butterworth Publishers, Boston. 1984. Volume edited by Thomas D. Crocker. Series edited by John I. Teasley. p 21-33, 5 Tab, 11 Ref.

Descriptors: *Cost analysis, *Acid rain, *Air pollution, *Water quality control, Precipitation, Economic aspects, Model studies, Mathematical models, Water pollution control, Sulfur oxides, Ambient least-cost control, State Implementation Plans, Fate of pollutants, Cuyahoga County, Cleveland, Ohio.

The use of ambient least-cost systems (ALC) offered substantial savings over the State Implementation Plans (SIP) in attaining compliance with ambient air quality standards with respect to acid emissions from powerplants. Using data on a set of 25 sulfur dioxide sources in Cuyahoga County in the Cleveland region of the Ohio River Basin, mathematical modeling showed that the substantial cost savings of the ALC strategy over the SIP strategy (about $14 million) was largely due to the long-range transport of locally generated sulfur dioxide. When constraints on sulfur oxide transport were introduced, the cost savings (about $2.5 million) of the ALC strategy were almost neutralized. The question was raised whether the remaining differential was substantial enough to cover the additional administrative costs of the ALC system and outweigh concerns about equity losses.
W86-00138

ECONOMIC IMPACT OF ACID PRECIPITATION: A CANADIAN PERSPECTIVE,
Oklahoma Univ., Norman. Div. of Economics.
B. A. Forster.
IN: Acid Precipitation Series, Volume 8: Economic Perspectives on Acid Deposition Control, Butterworth Publishers, Boston. 1984. Volume edited by Thomas D. Crocker. Series edited by John I. Teasley. p 97-121, 3 Fig, 2 Tab, 49 Ref.

Descriptors: *Water pollution effects, *Acid rain, *Air pollution, Precipitation, *Economic aspects, Ontario, Canada, Lakes, Fishing, Recreation, Taxes.

This paper reviews (1) economic theory relevant to controlling transboundary air pollution and (2) knowledge on the dose-response relationship between acid deposition and physical impacts in the natural environment. This is related to the potential economic significance of acid deposition in eastern Canada. In agriculture and forestry the available dose-response information is insufficiently conclusive to estimate monetary values with confidence. Aquatic effects of acid deposition are better understood than most other effects. In Ontario 48,000 lakes are considered sensitive to acidification, which could impact sport fishing, an important component in the province's tourism and recreation industry. Intangible aspects of the environment may also be affected. The increased uptake of mercury by fish in acidified waters also poses a health risk to persons who consume these fish. A survey of taxpayers' willingness to pay additional taxes to improve the environment at different levels is as yet incomplete. This uses 10 levels of environmental conditions rather than dollar amounts of damages.
W86-00142

ACIDIFICATION IMPACT ON FISHERIES: SUBSTITUTION AND THE VALUATION OF RECREATION RESOURCES,
Clarkson Univ., Potsdam, NY. Dept. of Economics.
For primary bibliographic entry see Field 5G.
W86-00144

TRANSFERABLE DISCHARGE PERMITS AND PROFIT-MAXIMIZING BEHAVIOR,
Wyoming Univ., Laramie. Dept. of Economics.
For primary bibliographic entry see Field 5G.
W86-00145

## 6D. Water Demand

WATER UTILITY OPERATING DATA: AN ANALYSIS,
Ames, IA.
H. F. Seidel.
Journal of American Water Works Association, Vol. 77, No. 5, p 34-41, May, 1985. 1 Fig, 12 Tab, 14 Ref.

Descriptors: *Utilities, *Surveys, Water demand, Water distribution, Municipal water, Costs, Rural areas.

Tha analyses of data gathered in AWWA surveys in 1976, 1978, and 1980 are simple - consisting primarily of means, medians, and frequency distributions for common water utility parameters. Water use in gallons per capita per day (liters per capita per day) was on a stable plateau from 1970 to 1980, with mean and median values of about 160 and 150 gpcd (606 and 568 L/d per capita), respectively. Analysis of rural water districts as a separate class was made possible for the first time by their increased participation in the 1980 survey. Their per-capita water use was somewhat less than that of similar municipal utilities, whereas their rates were from one third higher to double, depending on the size of the rural district. For municipal utilities, water rates essentially doubled from 1970 to 1980, but this was still not enough to keep up with inflation during the decade. (Author's abstract)
W86-00004

PUBLIC WATER SUPPLIES IN GLOUCESTER COUNTY, N.J.,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
For primary bibliographic entry see Field 2F.
W86-00174

PRESENT AND PROSPECTIVE USE OF WATER BY THE MANUFACTURING INDUSTRIES OF NEW JERSEY,
Illinois State Geological Survey Div., Champaign.
M. Grossman, and A. L. Sherman.
Water Resources Circular 11, June 14, 1963. 12 p, 1 Tab, 5 Exhibits.

Descriptors: *Water demand, *Water use, *Population dynamics, *New Jersey, *Future planning, Water requirements, Human population, Surveys, Water resources development.

The industries of New Jersey are increasing their use of publically supplied water. Planning for water requirements at least 20 yr in advance of actual need is recommended. In order to obtain, record and report data concerning water use by industry, a procedural manual should be prepared containing questionnaires for industries and managers of public supplies. A study of water use by all plants employing over 250 people is recommended for calendar year 1962. In addition, a survey of water use by all plants in one small New Jersey county is suggested. Population studies of New Jersey predicted an abnormally high increase in population in the suburban municipalities. Studies of employment showed that manufacturing, which is the principal industry of New Jersey, employs 50% of all those employed and uses about 90% of the water used by all industry.
W86-00175

GROUNDWATER MANAGEMENT STRATEGY FOR MICHIGAN: ECONOMIC AND SOCIAL IMPACTS OF GROUNDWATER CONTAMINATION; A CASE STUDY IN EAST BAY TOWNSHIP, GRAND TRAVERSE COUNTY, MICHIGAN.
Northwest Michigan Regional Planning and Development Commission, Traverse City.
For primary bibliographic entry see Field 5C.
W86-00218

WATER AND THE CITY,
Lund Univ. (Sweden). Dept. of Water Resources Engineering.
G. Lindh.
United Nations Educational, Scientific and Cultural Organization, Paris, France. 1983. 54 p.

Descriptors: *Urbanization, *Water demand, *Economic development, *Social impact, *Agriculture, Irrigation, Wastewater treatment, Water treatment, Planning, Environmental effects, Water supply, Water use, Saline soils, Groundwater, Rivers, Wells, Vegetation, Runoff, Urban runoff, Urban drainage, Floods, Subsidence, Storm water, Recharge, Public health, Combined sewers, Water transfer, Desalination.

This booklet traces the relationships between water and urban society from primitive times to the present and highlights some of the problems in water supply and quality. One of the major turning points in human history was irrigation, which was the beginning of food surpluses and the progression from farm to village to town to city to metropolis. In many regions of the world a water-demanding society has exploited water resources so that development costs rise dramatically. Early cultures, with few exceptions, have developed along rivers in Egypt, Mesopotamia, India, and China. However, some scholars postulate that water scarcity led to technological advances and improved agricultural practices. History records soil salination, pollution of watercourses with sewage and industrial wastes and other problems. The impact of city growth on water quantity and quality has increased with the size of cities and the loss of open land to building and paving. Urban flooding is an especially serious problem, destroying property and carrying pollutants. Water supply and wastewater treatment in developing countries and industrial regions are described. Examples of solutions are water transfer, reservoirs, seawater distillation, and individualized waste treatment and water pollution prevention schemes. As water demand increases, land subsidence and salt water intrusion increase. The importance of water planning and management is emphasized.
W86-00264

MODELING WATER DEMANDS.
Academic Press, New York, NY. 1984. J. Kindler and C.S. Russell, editors. 248 p, 205 Ref.

Descriptors: *Planning, *Water demand, *Water use, *Model studies, *Municipal water, Economic aspects, Water management, Water requirements, Forecasting, Water supply, Water policy, Regional planning, Industrial water, Agriculture, Linear programming, Statistical models, Mathematical models.

This book presents the basic concepts and techniques of water demand modeling. Several case studies undertaken by the International Institute for Applied Systems Analysis are given. Most planning is based on demand (price dependent water use) rather than on requirement (irreducible water use). Statistical or engineering approaches to modeling are described, and examples of both are given. Modeling techniques are applied to three aspects of water use: industrial, agricultural, and municipal. Modeling is extended to the regional and national levels. Difficulties with the national-level models are highlighted. However, they can provide enough information to avoid truly enormous mistakes in water management, for example, an unnecessary interregional water transfer.
W86-00270

WATER DEMAND,
B. T. Bower, J. Kindler, C. S. Russell, and W. R. D. Sewell.
In: Modeling Water Demands, Academic Press, New York, NY. 1984. p 1-22, 6 Fig, 1 Tab.

Descriptors: *Planning, *Water demand, *Water use, *Prices, *Model studies, Economic aspects, Water management, Water requirements, Elasticity of demand, Water quality, Water rates, Water policy, Water supply, Consumptive use.

The introductory chapter to the book, 'Modeling Water Demands,' defines the water demand problem and introduces relevant terms. Some functions of water resources management are planning, design, construction, and operation. Analyses of water use problems are divided under three headings: (1) baseline forecasting, (2) predicting impacts of direct policy intervention and indirect impacts of related policies, and (3) balancing use and supply. Several terms used in the analysis of water demand are defined. Demand and requirement are often used interchangeably. However, demand denotes the willingness of consumers to purchase a product, depending on the price; requirement means the quantity purchased regardless of price. Elasticity of demand is the percentage by which the quantity demanded changes for a 1% change in the price. The price of water may be determined by the interaction of supply and demand or through administrative decisions. Six dimensions of water demand are mentioned; these include withdrawals, gross water used, consumptive use, discharge, wastewater services demanded, and time patterns for the preceding dimensions. Water demand also has temporal variation--day to day, seasonally, and year to year.
W86-00271

METHODOLOGICAL FRAMEWORK,
International Inst. for Applied Systems Analysis, Laxenburg (Austria).
J. Kindler, and C. S. Russell.
In: Modeling Water Demands, Academic Press, New York, NY. 1984. p 23-50, 4 Fig.

Descriptors: *Planning, *Water demand, *Water use, *Model studies, Economic aspects, Water management, Water requirements, Linear programming, Water supply, Statistical models, Mathematical models.

Two types of water demand modeling are described--statistical and engineering. The statistical approach views an activity (example, steel mill) as a black box with inputs and outputs, not considering the processes occurring within the activity. The engineering approach details the activity with individual unit processes. Modeling by the statistical approach involves several steps: choosing the model structure, i.e., selecting variables and hypothesizing structural relationships; choosing functional forms; estimating model parameters; verifying and validating the model; and using the model. Mathematical programming can be applied to the engineering approach. Linear programming is shown as an example. Whichever approach is used, the model is verified and validated. Verification is the determination of whether or not the correct model has been developed from a given single set of data describing water demand relations. Validation is testing of the model against one or more independent sets of data. Choice of model type depends on data availability, skills and interests of the modeling team, available computational facilities, and the intended application.
W86-00272

INDUSTRIAL WATER DEMANDS,
Operational Economics, Inc., Houston, TX.
J. C. Stone, and D. Whittington.
In: Modeling Water Demands, Academic Press, New York, NY. 1984. p 51-100, 9 Fig, 3 Tab.

Descriptors: *Planning, *Water demand, *Water use, *Model studies, *Industrial water, *Pulp and paper industry, *Electric power industry, Economic aspects, Water management, Water requirements, Linear programming, Water supply, Statistical models, Mathematical models, The Netherlands, Poland, Prices, Cooling water.

Two approaches to modeling industrial water demand relationships are discussed and illustrated. The statistical approach is used to model demands for the Dutch paper industry. It focused on estimating water demand relationships and gives a list

of some econometric problems most likely to be encountered. Statistical estimation in the industrial water sphere is in its infancy. Problems include small sample sized available, lack of necessary data, and the simultaneous determination of price and quantity of water. The mathematical programming approach is illustrated wtih a determination of the water demand for electricity generation in Poland. The discussion includes a general description of the structure and components of the mathematical model, the process of model construction and specification, and model use and results.
W86-00273

AGRICULTURAL WATER DEMANDS,
I. V. Gouevsky, and D. R. Maidment.
In: Modeling Water Demands, Academic Press, New York, NY. 1984. p 101-147, 16 Fig, 5 Tab.

Descriptors: *Planning, *Water demand, *Water use, *Model studies, *Agriculture, *Irrigation, Livestock, Cattle, Economic aspects, Water management, Water requirements, Linear programming, Water supply, Mathematical models, Crop production, Bulgaria, Wheat, SWIM 2 model.

Agricultural water demands in crop production and livestock production are individually discussed. Water demands of individual and regional agricultural activities are considered, using as an example a linear programming model with a one type crop (wheat), one type animal (cattle) system. Among the information that can be derived from this simple example are the demand function for total irrigation water withdrawals and the demand function for wastewater discharges. The water demands of a large agroindustrial complex in the Silistra region of Bulgaria is analyzed and forecasted using the SWIM 2 model.
W86-00274

MUNICIPAL WATER DEMANDS,
Johns Hopkins Univ., Baltimore, MD. Dept. of Applied Economics.
S. H. Hanke, and L. de Mare.
In: Modeling Water Demands, Academic Press, New York, NY. 1984. p 149-169, 3 Fig, 8 Tab.

Descriptors: *Planning, *Water demand, *Water use, *Model studies, *Municipal water, Industrial water, Water loss, Malmo, Sweden, Statistical models, Economic aspects, Water management, Water requirements, Elasticity of demand, Water rates, Water supply, Prices.

Municipal water uses may be grouped into six categories, based on the volumes of water and wastewater involved and the timing of their use. The categories are residential, industrial, commercial transportation, public, and lost and unaccounted for water. Residential water use may be over half of total municipal use in many communities. Statistics on mean residential water use for different activities, in different types of residences, and diurnal patterns are presented. Commercial water use is variable--20-55 liters per employee-day in offices, 100 liters per employee-day in businesses with dirty conditions, and up to 1900 liters per day per washing machine in a laundry. Water use in public service activities are 630 liters per day per patient in a hospital, about 300 liters per day per patient in psychiatric facilities and nursing homes, 55-75 liters per day per student in schools with showers and cafeteria, and up to 200 liters per day per user in swimming pools. Leakage and undermetering are responsible for much lost and unaccounted for water, up to 50% in some systems. Statistical methods have proved more suitable for modeling municipal water demands than the engineering approach. An example of statistical modeling is given for residential water demand in the city of Malmo, Sweden.
W86-00275

PROGRAMMING MODELS FOR REGIONAL WATER DEMAND ANALYSIS,
Resources for the Future, Inc., Washington, DC.
C. S. Russell.
In: Modeling Water Demands, Academic Press, New York, NY. 1984. p 171-206, 11 Fig, 3 Tab.

Descriptors: *Planning, *Water demand, *Water use, *Model studies, *Regional planning, Delaware Valley, Statistical models, Economic aspects, Water management, Water requirements, Industrial water, Water quality, Wastewater treatment, Water supply, Estuaries, Mathematical models, Linear programming.

The design and construction of regional water demand models uses mathematical programming models of individual water use activities, such as industrial, agricultural, and municipal. Since regional models can easily become enormous and complicated, techniques for size reduction and simplification are given. A regional modeling project involving the lower Delaware Valley is used as an example. Although it deals only with water quality and not quantity, many of the principles of model design and size reduction are illustrated. Since each region is unique, models must be custom-built. A handbook which combines standardized parts to produce a regional model is not yet available.
W86-00276

NATIONAL PERSPECTIVE IN WATER DEMAND MODELING,
International Inst. for Applied Systems Analysis, Laxenburg (Austria).
J. Kindler, and C. S. Russell.
In: Modeling Water Demands, Academic Press, New York, NY. 1984. p 207-219, 3 Fig, 2 Tab.

Descriptors: *Planning, *Water demand, *Water use, *Model studies, *Municipal water, Economic aspects, Water management, Water requirements, Forecasting, Water supply, Water policy, Regional planning.

Attempts to apply the concept of water demand to the national level are difficult and of limited relevance. Most work has been directed toward use rather than demand. Baseline forecasting, usually undertaken to identify problems before the crisis stage, is not too effective on a national basis. To get the best results, forecasting should be done on a regional basis with some consideration of upstream/downstream relations. Several national water studies are described. Poland has a long history of national water studies dating to 1953-56. A macro interregional linear programming model U.S. agriculture provides much information on least-cost distribution of agricultural production. A water use forecasting study done in Japan in the 1970s has five major components: a macroeconomic model-input-output model and four submodels (municipal, household, industrial, and agricultural). When national aggregated projections of water use are made, several problems develop. Possible intraregional problems are understated or eliminated. The models also overstate net withdrawal totals by ignoring reuse. If the water use exceeds the supply on a national basis, large and wasteful water supply projects or irrigation projects are often conceived without regard to regional conditions.
W86-00277

## 6E. Water Law and Institutions

NATIONAL WATER SUMMARY 1983--HYDROLOGIC EVENTS AND ISSUES.
Geological Survey, Reston, VA. Water Resources Div.
For primary bibliographic entry see Field 6B.
W86-00131

ACID RAIN: DOES SCIENCE DICTATE POLICY OR POLICY DICTATE SCIENCE,
Georgia Univ., Athens. Inst. of Natural Resources.
J. L. Regens.
IN: Acid Precipitation Series, Volume 8: Economic Perspectives on Acid Deposition Control, Butterworth Publishers, 1984. Volume edited by Thomas D. Crocker. Series edited by John I. Teasley. p 5-19, 2 Tab, 48 Ref.

Descriptors: *Policy making, *Acid rain, *Water quality control, *Air pollution, Precipitation, Fallout, Monitoring, Sulfur oxides, Fate of pollutants, Model studies, Research priorities, Water pollution effects, Environmental effects, Economic aspects, Decision making, Public policy, Water pollution control.

Research can contribute significantly to reducing the current level of uncertainty about the causes and consequences of the acid deposition problem. However, science can never provide the last word with absolute certainty. Clearly, such a mission represents an impossible task, although research can be used to improve significantly the quality of information in areas important for decision-makers. Enhanced understanding of the causal factors and potential consequences of acid deposition enables policymakers to identify and select those courses of action which, given their own value systems, address most appropriately the problem. Thus, science neither dictates the policy nor policy the science. Instead, a symbiotic relationship exists between the two. Knowledge from one domain can foster choice in the other. (Author)
W86-00137

LEGAL, ETHICAL, ECONOMIC AND POLITICAL ASPECTS OF TRANSFRONTIER POLLUTION,
Resources for the Future, Inc., Washington, DC.
A. V. Kneese, and R. C. D'Arge.
IN: Acid Precipitation Series, Volume 8: Economic Perspectives on Acid Deposition Control, Butterworth Publishers, Boston. 1984. Volume edited by Thomas D. Crocker. Series edited by John I. Teasley. p 123-133, 1 Tab, 13 Ref.

Descriptors: *Political constraints, *International agreements, *Water pollution effects, Economic aspects, Legal aspects, Ethics, Efficiency, Jurisdiction, Liability, Negotiations.

Compensated and uncompensated transnational pollution problems have been analyzed. Compensation among nations is necessary to achieve economic efficiency, in that costs and benefits will be adequately compared. For many Western ethical criteria, uncompensated risks imposed by one nation on others could be unethical, but this depends on the ethical criterion as well as differences in income and other political considerations. Because of differences in the mix of ethical beliefs among nations along with the desire to maintain national sovereignty, no all-inclusive principle is likely to emerge to solve transnational pollution problems. What is likely to emerge is a sequence of relatively unique solutions that blend economic necessity with political cunning and goodwill. However, the first step appears to be that every nation agrees to negotiate in good faith toward a solution of transnational pollution provided there is sufficient evidence of economic benefit and cost. The record on international settlement of transnational pollution does not lead to a clear and concise set of guiding international principles. The various cases demonstrate the various possibilities ranging from full costing to victim pays. It is unlikely that such piecemeal solutions will lead to economic efficiency in a global sense. Yet, as long as there are gains from trade, including pollution, among nations, and these gains from trade are negotiated over and obtained, everyone should be as well off or better than without negotiation. (Author)
W86-00143

SURVEY OF NATIONAL AND STATE REGULATORY AGENCY POLICY AND PROCEDURES FOR THE DETERMINATION OF THE TOXICITY OF WASTEWATER EFFLUENTS.
Ecological Analysts, Inc., Sparks, MD.
API Publication 4353, American Petroleum Institute, Washington, DC., November 1982. 133 p, 1 Fig, 7 Tab, 6 Ref, 2 Append.

Descriptors: *Toxic wastes, *Public policy, *Water pollution effects, *Standards, *Wastewater management, *Toxicity, *Industrial wastes, Bioassay, Aquatic animals, Permits, State jurisdiction, Regulations, Oil refineries, Water policy, Surveys.

The U.S. EPA and state regulatory agencies use effluent toxicity testing on a case-by-case basis to

evaluate the acute toxicity of effluents. It appears likely that effluent toxicity testing, especially given the activities in U.S. EPA Region VI, and other water quality-based regulatory procedures will be used in upcoming years to help evaluate point source industrial discharges. The extent and degree to which this occurs will depend on the direction and guidance developed by U.S EPA in Washington, D.C., the specific U.S. EPA regional offices, and the individual states. Since use of effluent toxicity testing during the issuance of the second round of NPDES permits is dynamic, status of effluent toxicity testing in each state should be carefully investigated before making final environmental management decisions. (Author)
W86-00211

**WATER AND THE CITY,**
Lund Univ. (Sweden). Dept. of Water Resources Engineering.
For primary bibliographic entry see Field 6D.
W86-00264

**OPPORTUNITIES TO PROTECT INSTREAM FLOWS IN ALASKA,**
M. R. White.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-124974. FWS/OBS-82/33, July 1982. Fish and Wildlife Service, Washington, DC. Office of Biological Services. 30 p, 2 Tab, 45 Ref. Contract/Grant No. 14-16-009-79-100.

Descriptors: *Water law, *Water policy, *Alaska, *Water management, *Rivers, Instream flow, Fish, Aquatic life, Rivers, Resources management, Water use, Appropriation, Legal aspects, Legislation, Water rights, Permits, Land acquisition, Wildlife, Water resources.

This report, intended for the use of planning and management personnel, identifies and describes promising opportunities for protecting instream uses of water under existing Alaskan law. It is designed as a guide through the Federal and state statutes and administrative practices. Sections include Department of Natural Resources conditions on appropriative rights, reservation of instream flows, Department of Fish and Game acquisition of land and water, anadromous fish permits, pollution laws, municipal condemnation, Renewable Resources Fund, coastal zone management, Marine Fisheries Compact, and Public Trust Doctrine.
W86-00280

## 6F. Nonstructural Alternatives

**FLOOD DAMAGE ALLEVIATION IN NEW JERSEY,**
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
S. Dola.
Water Resources Circular 3, New Jersey State Dept. of Conservation and Economic Development, 1961. 20 p, 22 Ref.

Descriptors: *Flood plain zoning, *Flood plain management, *Flood control, *Flood damage, *New Jersey, Water resources development, Flood protection, Flood plains, Zoning.

New Jersey is faced with serious flood problems due to increasing population and development in flood prone areas such as the Passaic and Delaware river basins. Only through Federal participation in the construction of engineering structures such as dams and local protective works can future flood damage to existing developments be reduced. The U.S. Army Corp of Engineers is now compiling data on floods and flood damages to promote better zoning in the Passaic Valley. The U.S. Weather Bureau is conductng flood forecasting in the Delaware, Raritan, and Passaic river valleys. The Soil Conservation Service gives technical, cost-sharing, and credit aid to local organizations in planning and carrying out works of improvement for flood prevention, and agricultural and nonagricultural water management. The U.S. Geological Survey gathers data on floods by gaging streams throughout New Jersey. The municipal encroachment law permits municipalities to construct improvements, remove obstructions, define the location, establish widths, grades, and elevations of any stream and to prevent encroachments thereon of the flood carrying capacity to be provided. The 1929 Encroachment Law for flood damage alleviation in New Jersey is basically a preventive measure approach. The Tennessee Valley plan for flood plain regulation would divide the responsibility between state and local governments.
W86-00173

## 6G. Ecologic Impact Of Water Development

**REVIEW OF THE EFFECTS OF WATER-LEVEL CHANGES ON RESERVOIR FISHERIES AND RECOMMENDATIONS FOR IMPROVED MANAGEMENT,**
Fish and Wildlife Service, Fayetteville, AR. National Reservoir Research Program.
G. R. Ploskey.
Technical Report E-83-3, February 1983. Final Report. U.S Army Environmental and Water Quality Operational Studies, Army Engineer Waterways Experiment Station, Vicksburg, MS. 83 p, 203 Ref. Intra-Army Order WESRF-82-24.

Descriptors: *Reservoir fisheries, *Fish, *Water level, Water properties, Water level fluctuations, Reservoir releases, Water temperature, Reservoir operation, Ecosystems, Erosion, Turbidity, Chemical properties, Dissolved oxygen, Fish harvest, Nutrients, Flooding, Drawdown, Aquatic plants, Benthos, Spawning, Zooplankton, Literature review.

Information gathered from available literature sources about the physico-chemical and biological effects of water-level changes on reservoir ecosystems is summarized. The effects of variations in both the physical environment (i.e., basin morphometry, bottom substrates and structures, erosion turbidity, temperature, and water-retention time) and the chemical environment (i.e., nutrients and dissolved oxygen) caused by water-level changes on a reservoir's production of fish are described. The complex ways in which water-level changes affect aquatic plants, zooplankton, and the benthos and how these trophic variations can eventually affect the growth, reproduction, and harvest of fish are discussed. The final part of the report summarizes the effects of drawdown and flooding on reservoir fish populations and recommends ways to manage reservoir fluctuation zones by making controllable variables (magnitude, frequency, and timing of water-level change) as favorable as possible for fish survival, spawning, and feeding.
W86-00158

**TECHNIQUES TO REDUCE THE SEDIMENT RESUSPENSION CAUSED BY DREDGING,**
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
For primary bibliographic entry see Field 5G.
W86-00159

**LONG-TERM IMPACT OF DREDGED MATERIAL AT TWO OPEN-WATER SITES: LAKE ERIE AND ELLIOT BAY; EVALUATIVE SUMMARY,**
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
For primary bibliographic entry see Field 5C.
W86-00160

**FISHES OF SELECTED AQUATIC HABITATS ON THE LOWER MISSISSIPPI RIVER,**
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
C. H. Pennington, J. A. Baker, and C. L. Bond.
Technical Report E-83-2, January 1983. Final Report. 96 p, 22 Fig, 19 Tab, 39 Ref, Append.

Descriptors: *Environmental effects, *Aquatic habitats, *Fish, *Channel improvement, Mississippi River, Dikes, Stream banks, Banks, Erosion control, Revetments, Bank erosion, Flood control, Habitats, Aquatic animals.

Fish species diversity, abundance, and distribution were studied in four habitats (dike fields, revetted banks, natural banks, and an abandoned river channel) in the Lower Mississippi River near Greenville, Mississippi. The largest number of fish species was found in the dike field habitat (53), followed by the abandoned channel (31), revetted banks (27), and natural banks (24). Dike fields were similar at most sampling periods with respect to species composition but were often different in the relative abundances of the constituent species. The natural banks were generally similar in species composition and relative abundance, while the revetted banks showed greater variability and overall lower similarity. The numerical catch per unit effort was seldom significantly different among habitats. Catches on revetted banks were generally higher than on natural banks. In November 1979 the catch per unit effort was 7 times that of any other habitat. Biomass catch per unit effort was greatest in the revetted bank habitat, followed in order by dike fields, natural banks, and abandoned channel, with two exceptions. In April 1979 the biomass catch per unit effort in the abandoned channel was greater in dike fields and natural banks than in revetted banks; in November 1979 the biomass catch per unit effort was greatest in the abandoned channel. Condition factors were not significantly different among the habitats or seasons. Age 0 fish were abundant in dike fields and, to a lesser extent, in the abandoned channel. Mostly adult fish were collected at natural banks and revetted banks.
W86-00195

**LARGE-SCALE OPERATIONS MANAGEMENT TEST OF USE OF THE WHITE AMUR FOR CONTROL OF PROBLEM AQUATIC PLANTS: THE HERPETOFAUNA OF LAKE CONWAY, SPECIES ACCOUNTS,**
University of South Florida, Tampa. Dept. of Biology.
G. T. Bancroft, J. S. Godley, D. T. Gross, N. N. Rojas, and D. A. Sutphen.
Miscellaneous Paper A-83-5, July 1983. Final Report. U.S. Army Aquatic Plant Control Research program, Army Engineer Waterways Experiment Station, 304 p, 62 Fig, 42 Tab, 104 Ref, 2 Append.

Descriptors: *Weed control, *Environmental effects, *Aquatic weed control, *Wildlife, *Lakes, Aquatic animals, *Reptiles, *Amphibians, Snakes, Frogs, Turtles, Fish, White amur, Lake Conway, Florida, Ecosystems, Aquatic habitats, Habitats, Salamanders, Alligators.

Species accounts of the herpetofauna of Lake Conway, Florida, were developed to assess any changes resulting from use of the white amur to control aquatic plants. During 1977-1980 ecological were recorded for 2 of 4 salamanders, all 8 frogs, the American alligator, 5 of 10 turtles, and 1 of 7 snakes. The change most often noticed was a change in relative density, followed by seasonal activity, population structure, open water habitat use, food habits, and movement patterns. No yearly variation was detected in the use of specific littoral zone habitats, growth rates, or reproductive output per individual. The white amur was implicated in ecological changes in 1 salamander and 3 turtle species. This was related to macrophyte removal by the fish, combined with other disturbance phenomena: shoreline development, destruction or removal of individuals from the lake system, boat propeller mortality, investigator efforts, water level fluctuations, and weather conditions.
W86-00202

**AQUATIC HABITAT STUDIES ON THE LOWER MISSISSIPPI RIVER: RIVER MILE 480-530; REPORT 3: BENTHIC MACROINVERTEBRATE STUDIES PILOT REPORT,**
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.

D. B. Mathis, S. P. Cobb, L. G. Sander, A. D. Magoun, and C. R. Bingham.
Miscellaneous Paper E-80-1, April 1981. Report 3 of a Series. 83 p, 12 Fig, 16 Tab, 8 Ref.

Descriptors: *Environmental effects, *Ivertebrates, *Waterways, *Aquatic habitats, Habitats, Mississippi River, Aquatic animals, Aquatic life, Macroinvertebrates, Benthos, Channels, Dikes, Sand, Banks, Stream Banks, Flow control, Caddisflies, Mayflies, Oligochaetes, Aquatic insects, Insects, Chironomids.

Benthic macroinvertebrates were sampled on the Lower Mississippi River, River Mile 480 to 530. A total of 20,562 organisms, representing 72 distinct taxa, 17 orders, and 5 classes were collected. The three most productive habitats were dike structures (563.4 organisms per rock sample), abandoned channels (70.04 organisms per 0.05 sq m), and natural banks (9.4 organisms per 0.05 sq m). The dike structures contained primarily caddisflies, chironomid larvae, and mayflies. Abandoned channels contained oligochaetes, dipteran larvae, and fingernail clams. Natural banks featured burrowing mayflies and clinging macroinvertebrates. These three habitats were relatively stable compared with the other less productive habitats, dike fields, revetted banks, permanent secondary channel, temporary secondary channel, main channel, and sand bars.
W86-00212

**EFFECTS OF BEACH NOURISHMENT ON THE NEARSHORE ENVIRONMENT IN LAKE HURON AT LEXINGTON HARBOR (MICHIGAN),**
Coastal Engineering Research Center, Fort Belvoir, VA.
R. T. Nester, and T. P. Poe.
Miscellaneous Report No. 82-13, November 1982. 56 p, 5 Fig, 10 Tab, 17 Ref, 5 Append. Project No. G31533.

Descriptors: *Environmental effects, *Erosion control, *Beaches, *Shore protection, *Lakes, Lake Huron, Lexington Harbor, Michigan, Benthos, Invertebrates, Fish, Water quality, Protection, Dredging, Bottom sediments, Suspended sediment, Turbidity.

A beach nourishment project at Lexington Harbor, Michigan, had no significant adverse effect on the nearshore aquatic environment, as determined by aerial photography, water analysis, and sampling of lake bottom sediments, macrozoobenthos, and fish. However, the beach face profile changed markedly during the 14-month study. By the end of the study, a moderate lakeward extension of the beach face was present in the area immediately south of the harbor.
W86-00224

**AQUATIC HABITAT STUDIES ON THE LOWER MISSISSIPPI RIVER: RIVER MILE 480-530; REPORT 6: LARVAL FISH STUDIES PILOT REPORT,**
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
H. L. Schramm, and C. H. Pennington.
Miscellaneous Paper E-80-1, April 1981. Report 6 of a Series. 74 p, 4 Fig, 29 Tab, 10 Ref.

Descriptors: *Environmental effects, *Aquatic habitats, *Fish, *Waterways, Habitats, Mississippi River, Aquatic animals, Aquatic life, Larvae, Channels, Dikes, Sand, Banks, Stream banks, Flow control, Oxbow lakes, Sampling, Diurnal distribution, Herring, Carp.

Larval fish were collected in 9 habitats in the Lower Mississippi River during the spawning season. Abandoned channels and oxbow lakes had relatively low diversity and high densities of clupeids and centrarchids. Natural banks and revetted banks had high density and abundance of larval fish. Dike fields had high diversity and moderate density of larval fish. Three of the four main channel sampling stations showed low diversity and density of larval fish. The fourth main channel had high diversity and high density on two sampling dates. In temporary secondary channels the density of larval fish was low and the diversity was high. Both density and diversity were low in the permanent secondary channel and in the sand bar. The number of taxa and the density of larvae were greatest at dusk. Twelve taxa were collected only at dusk, dawn, or at night. Samples taken within a 1- to 2-hour period of a diel cycle did not constitute significant amounts of the variation in number of taxa or density of larval fish. In addition, samples collected with paired nets did not constitute a significant portion of the variation in number of taxa but did constitute a significant portion of the variation in density.
W86-00226

**FLOOD CONTROL MINNESOTA RIVER, MINNESOTA, MANKATO-NORTH MANKATO-LEHILLIER: DESIGN MEMORANDUM NO. 8, PART I (LOCATION STUDY).**
Army Engineer District, St. Paul, MN.
For primary bibiiographic entry see Field 8A.
W86-00238

**GUIDE TO STREAM HABITAT ANALYSIS USING THE INSTREAM FLOW INCREMENTAL METHODOLOGY,**
Fish and Wildlife Service, Fort Collins, CO. Western Energy and Land Use Team.
K. D. Bovee.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-131052. Report No. FWS/OBS-82/26, June 1982. 249 p, 52 Fig, 31 Tab, 78 Ref, 2 Append.

Descriptors: *Environmental effects, *Streams, *Habitats, *Water analysis, *Aquatic life, Planning, Rivers, Instream Flow Incremental Methodology, Instream flow, Water yield, Sediment yield, Channel flow, Channeling, Water quality, Watersheds, Land use, Aquatic habitats, Aquatic animals, Reservoirs, Fish passages, Channel improvement, Hydrology, Water resources development.

The Instream Flow Incremental Methodology has been expanded and refined to produce an approach to the assessment of riverine habitats and the impact of disturbances on these habitats. The first chapters of this user's guide explain the overall approach of the methodology, describe activities that preceed data collection, show the sequence of data collection, and detail options for preparing, displaying, and interpreting the output. The later chapters contain necessary concepts of hydrology and channel dynamics and the Physical Habitat Simulation System. Stream habitat can be defined in terms of macrohabitat (temperature, water quality, sediment size and load, channel shape, slope, and flow regime) or microhabitat (distribution of depth, velocity, substrate, and cover within a specific area of the stream). Macrohabitat characteristics affect the longitudinal distribution of species and create longitudinal gradations in the microhabitat characteristics along the stream. The total habitat availability at any flow is defined by the area of overlap between suitable macrohabitat conditions and available microhabitat area. Total habitat may be determined with or without a project such as reservoir construction or channel improvement.
W86-00251

**NORFOLK HARBOR AND CHANNELS DEEPENING STUDY, REPORT 1: PHYSICAL MODEL RESULTS, CHESAPEAKE BAY HYDRAULIC MODEL INVESTIGATION,**
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
For primary bibliographic entry see Field 2L.
W86-00266

# 7. RESOURCES DATA

## 7A. Network Design

**SYNTHESIS OF RADAR RAINFALL DATA,**
National Weather Service, Silver Spring, MD. Hydrologic Research Lab.
For primary bibliographic entry see Field 2A.
W86-00084

## 7B. Data Acquisition

**STREX TOVS/RADIOSONDE COMPARISON, PART I: TOVS/AVHRR AND RADIOSONDE INVENTORY,**
National Oceanic and Atmospheric Administration, Seattle, WA. Pacific Marine Environmental Lab.
H. M. Byrne.
NOAA Data Report ERL PMEL-8, October 1982. 135 p, 3 Append.

Descriptors: *Remote sensing, *Satellite technology, *Radiosondes, *Meteorological data collections, STREX, NAVAID, TOVS, AVHRR, Measuring instruments.

This report consists of four appendixes of data generated in 110 overpasses of the NOAA-6 polar orbiter. Appendix A is a catalog of 123 computer-generated coverage maps of the overpasses. They show the coverage of the AVHRR scanner during the pass and the coverage of the TOVS instruments. Appendix B tabulates the STREX NAVAID radiosonde and aircraft dropsonde data taken during the experiment. Appendix C consists of lists of translated passes including orbit number, data, and time, and the archive tape label at the University of Miami. Appendix D is the tabulation of the NAVAID radiosonde computer printouts on microfiche.
W86-00187

**ARCTIC MARINE OILSPILL PROGRAM (AMOP) REMOTE SENSING STUDY,**
Canada Centre for Remote Sensing, Ottawa (Ontario).
R. A. O'Neil.
Report EPS 4-EC-83-3, March 1983. Environmental Protection Service, Ottawa, Ontario. 257 p, 103 Fig, 6 Tab, 79 Ref, 10 Append.

Descriptors: *Remote sensing, *Satellite technology, *Path of pollutants, *Oil spills, Arctic, Cold regions, Ice, Oil slicks, Canada, Arctic Marine Oilspill Program, Radar, Television, Photography, Infrared imagery, Kurdistan, Nova Scotia, Montreal Harbor, Scott Inlet, Data aquisition.

The Arctic Marine Oilspill Program studied remote sensing of oil slicks on ice-infested waters. Experiments were conducted in Montreal Harbor, Scott Inlet, off the New Jersey coast, and off the Nova Scotia coast (Kurdistan spill). A recommended integrated sensor package included a side-looking radar, an ultraviolet-infrared dual channel line scanner, a laser fluorosensor, a low-light-level television, and annotated photographic cameras. A real-time display system was recommended to allow operator interaction with the sensors.
W86-00258

**BOULDER UPSLOPE CLOUD OBSERVATION EXPERIMENT.**
National Oceanic and Atmospheric Administration, Boulder, CO. Environmental Research Labs.
For primary bibliographic entry see Field 2B.
W86-00261

**USE OF SATELLITE IMAGERY FOR TRACKING THE KURDISTAN OIL SPILL,**
Remotec Applications Ltd., St. John's (Newfoundland).
B. R. Dawe, S. K. Parashar, J. P. Ryan, and R. D. Worsfold.
Report EPS 4-EC-81-6, December 1981. Environmental Protection Service, Ottawa, Ontario. 31 p, 19 Fig, 3 Tab, 10 Ref.

Descriptors: *Remote sensing, *Satellite technology, *Oil spills, Oil slicks, Kurdistan, Path of pollutants, LANDSAT, TIROS, Ice, Cape Breton Island, Infrared imagery.

The effectiveness of using satellite imagery in locating, monitoring, and tracking oil spills in open water was studied after the tanker Kurdistan broke in two pieces in ice off Cape Breton Island on March 15, 1979. The accident released 7000 metric tons of Bunker C oil. Results of the study were inconclusive. A major oil slick was located on only one occasion. At this time only TIROS AVHRR imagery with a reduced dynamic range (2 significant bits missing) was available. All other TIROS and LANDSAT data had no confirmed slicks within the imaged areas. Sun elevations and wind speeds were unfavorable for detection of oil slicks by satellite imagery. However, LANDSAT data detected a confirmed oil-on-ice slick in Gabarouse Bay. Band 4 provided the best contrast, whereas Band 7 was the worst. TIROS imagery over an oil-ice area did not detect an oil slick.
W86-00291

## 7C. Evaluation, Processing and Publication

**MONITORING OF RESERVOIR VOLUME USING LANDSAT DATA,**
Roorkee Univ. (India). Dept. of Earth Sciences.
R. P. Gupta, and S. Banerji.
Journal of Hydrology, Vol. 77, p 159-170, 1985. 7 Fig, 1 Tab, 18 Ref.

Descriptors: *Reservoir storage, *Remote sensing, *Landsat, *Satellite technology, *Ramganga dam reservoir, *India, Mountain lakes, Water depth, Topography, Lake morphology, Lake morphometry.

Measuring depth of a water body by remote sensing is limited by several factors such as turbidity, depth of water, type of bedrock material, wavelength used, etc. Measurement of width, length and area of a reservoir can be done rather easily with the help of satellite data. The accuracy of areal estimation is limited by the areal resolution of the sensor and topographic milieu. Computing lake surface area for estimating water volumes would have limited applicability in areas of high topographic relief. A method which was suggested by others and involves marking of land-water contact from satellite data along low-gradient channels was applied to the Ramganga dam reservoir (Himalayas, India) using Landsat MSS CCT's, field spectro-radiometric measurements and theodolite surveys. The technique can be utilized in areas of known topography for real-time remote monitoring of fluctuations in reservoir volume. The elevation data obtained are very close to the recorded water level; taking design data as the standard data gives + or - 0.24% accuracy. For the sake of comparison, an attempt was also made to compute water volume by measuring lake surface area from the satellite data. The area of the reservoir can be measured upto an accuracy of + or - 5.14%. Some element of inaccuracy in measuring reservoir surface area could be due to rugged relief and shadows. (Collier-IVI)
W86-00032

**WATER RESOURCES DATA FOR FLORIDA, WATER YEAR 1981 VOLUME 1: NORTHEAST FLORIDA.**
Geological Survey, Orlando, FL. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-170753. USGS Water Data Report FL-81-1, 1982. 591 p, 34 Fig, 1 Tab.

Descriptors: *Florida, *Hydrologic data, *Surface water, *Groundwater, *Water quality, Flow rate, Gaging stations, Lakes, Reservoirs, Chemical analyses, Sediments, Water temperatures, Sampling sites, Water levels, Water analyses, Elevations, Water wells, *Data collections.

Water resources data for the 1981 water year in Florida consists of continuous or daily discharge for 279 streams, periodic discharge for 52 streams, continuous or daily stage for 64 streams, periodic stage for 82 streams, peak discharge for 78 streams and peak stage for 55 streams; continuous or daily elevations for 77 lakes, periodic elevations for 144 lakes; continuous ground water levels for 483 wells, periodic ground water levels for 661 wells, and miscellaneous water level measurements for 2,807 wells; quality of water data for 301 surface water sites and 842 wells. The data for northeast Florida includes continuous or daily discharge for 57 stream, periodic discharge for 6 streams, miscellaneous discharge for 62 streams, peak discharge for 29 steams, low-flow discharge for 2 streams, continuous or daily stage for 28 streams; continuous elevations for 20 lakes and periodic elevations for 30 lakes; continuous ground water levels for 31 wells, periodic ground water levels for 116 wells, and miscellaneous water level measurements for 636 wells; quality of water for 80 surface water sites and for 702 wells. (USGS)
W86-00127

**WATER RESOURCES DATA FOR COLORADO, WATER YEAR 1982, VOLUME 2. COLORADO RIVER BASIN ABOVE DOLORES RIVER,**
Geological Survey, Lakewood, CO. Water Resources Div.
R. C. Ugland, J. T. Steinheimer, J. L. Blattner, and R. G. Kretschman.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-120138. USGS Water Data Report CO-82-2, 1983. 339 p, 6 Fig, 5 Tab. Prepared in cooperation with the State of Colorado and other agencies.

Descriptors: *Colorado, *Hydrologic data, *Surface water, *Groundwater, *Water quality, Flow rate, Gaging stations, Lakes, Reservoirs, Chemical analyses, Sediments, Water temperatures, Sampling sites, Water levels, Water analyses, *Data collections, Colorado River basin.

Water-resources data for Colorado for the 1982 water year consists of records of stage, discharge, and water quality of streams; stage, contents, and water quality of lakes, and reservoirs, and water levels and water quality of wells and springs. This report (Volumes 1, 2, and 3) contains discharge records for 408 gaging stations, stage and contents of 27 lakes and reservoirs, 6 partial-record low-flow stations, peak-flow information for 30 crest-stage partial-record stations, and 50 miscellaneous sites; water quality for 163 gaging stations and 245 miscellaneous sites; and water levels for 55 observation wells. Nine pertinent stations in bordering States are also included in this report. The records were collected and computed by the Water Resources Division of the U.S. Geological Survey under the direction of J. F. Blakey, District Chief. (USGS)
W86-00128

**WATER RESOURCES DATA, NORTH DAKOTA, WATER YEAR 1981, VOLUME 1. HUDSON BAY BASIN.**
Geological Survey, Bismarck, ND. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83 213785. USGS Water Data Report ND-81-1, 1982. 325 p, 7 Fig.

Descriptors: *North Dakota, *Hydrologic data, *Surface water, *Groundwater, *Water quality, Flow rate, Gaging stations, Lakes, Reservoirs, Chemical analysis, Sediments, Water temperatures, Sampling sites, Water levels, Water analyses, *Data collections, Hudson Bay basin.

Water resources data for the 1981 water year for North Dakota consist of records of stage, discharge, and water quality of streams; stage, contents, and water quality of lakes and reservoirs; and water levels and water quality of ground water. Volume 1 of this report contains 67 gaging stations; stage only records for 6 gaging stations; stage and contents for 4 lakes and reservoirs; water quality for 24 gaging stations; 10 partial-record stations, 14 lakes, 26 wells, and water levels for 19 observation wells. Additional water data were collected at various sites, not involved in the systematic data collection program, and are published as miscellaneous measurements. (USGS).
W86-00129

**WATER RESOURCES DATA HAWAII, OTHER PACIFIC AREAS, WATER YEAR 1981. VOLUME 2. GUAM, NORTHERN MARIANA ISLANDS, FEDERATED STATES OF MICRONESIA, PALAU ISLANDS AND AMERICAN SAMOA.**
Geological Survey, Honolulu, HI. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83 171116. USGS Water-Data Report HI-81-2, 1982. 148 p, 16 Fig.

Descriptors: *Pacific area, *Hydrologic data, *Surface water, *Groundwater, *Water quality, *Flow rate, Gaging stations, Chemical analyses, Sediments, Reservoirs, Water temperatures, Sampling sites, Water levels, *Data collections.

Volume 2 of water resources data for the 1981 water year for other Pacific areas consist of records of stage, discharge, and water quality of streams; stage of a reservoir; and water levels in wells and springs. This report contains discharge record for 41 gaging stations; stage only record for 2 gaging stations; water quality for 3 gaging stations, 39 partial-record stations; water temperature for 60 gaging stations; and water levels for 10 observation wells. Also included are 47 low-flow partial-record stations. Additional water data were collected at various sites, not part of the systematic data collection program, and are published as miscellaneous measurements. (USGS).
W86-00130

**SEDMNT: A SEDIMENT TRANSPORT SUBMODEL BASED ON HYDRODYNAMIC PRINCIPLES FOR THE UNIFIED TRANSPORT MODEL,**
Oak Ridge National Lab., TN. Environmental Sciences Div.
For primary bibliographic entry see Field 2J.
W86-00155

**FOUNDATIONS OF PRINCIPAL COMPONENT SELECTION RULES,**
Scripps Institution of Oceanography, La Jolla, CA.
R. W. Preisendorfer, F. W. Zwiers, and T. P. Barnett.
SIO Reference Series 81-4, May 1981. 192 p, 37 Fig, 33 Tab, 75 Ref.

Descriptors: *Data processing, *Data interpretation, *Model studies, *Temperature, Air temperature, Meteorology, Principal component analysis, Mathematical studies.

The problem of separating signal from noise in a given space-time data set of geophysical fields which has been rendered into its principal component representation is considered. These separations are effected by two main sets of selection rules: dominant-variance and time-history. The dominant-variance rules are based on the fact that the covariance matrix of the sum of a signal and a noise data set generally have a recognizably different eigenvalue curve than that of each of the two summands so that, under hypothesized noise and sampling conditions, the presence of a signal can be inferred with a chosen level of confidence. The time-history rules are based on the temporal evolution of the given data set's principal component series, and test the hypothesis that the series are of a given noise type. A rejection of the hypothesis about a particular component series at a given level of confidence results in the selection of the principal component as potentially signal-like. Nine dominant-variance rules and eight time-history rules were tested. Methods of interpreting principal component representations of data sets are given. Suggestions are also given for associating possible underlying dynamical models to these representations.
W86-00186

# 8. ENGINEERING WORKS

## 8A. Structures

**OPTIMAL URBAN WATER DISTRIBUTION DESIGN,**
MacLaren Engineers, Winnipeg (Manitoba).
For primary bibliographic entry see Field 5F.
W86-00071

**WEIR JETTY PERFORMANCE: HYDRAULIC AND SEDIMENTARY CONSIDERATIONS, HYDRAULIC MODEL INVESTIGATION,**
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
W. C. Seabergh.
Technical Report HL-83-5, March 1983. Final Report. 298 p, 43 Fig, 3 Tab, 59 Photos, 105 Plates, 32 Ref, 2 Append.

Descriptors: *Performance evaluation, *Jetties, *Hydraulic models, Tidal rivers, Sediment transport, Tidal hydraulics, Flood flow, Ebb flow, Sediment control.

This study was performed to quantify the design parameters of an efficient sediment-handling weir jetty system. A 150-ft by 350-ft facility, yielding a 1:100 scale, in which the bay area was either partially filled (low Keulegan K value) of nearly filled (high Keulegan K value), was used to provide extremes of velocity-tidal elevation flow relationships over the weir. Sediment tracers and a movable-bed beach section provided the means to examine the deposition. Results indicate the mean tidal level weir elevation is the most practical elevation for providing wave protection for a dredge, good sediment transport across the weir, and good flood-ebb tidal flow relationships. Strong ebb flow currents over the weir are not desirable as they might aid in migration of the navigation channel through the deposition basin. Jetty systems with the outer, more oceanward portions parallel to each other and at minimum spacing provide the best flow characteristics when tidal current migration through the deposition basin region is considered. Wave-generated currents upcoast of the weir jetty are not entirely captured by the weir but some current, and thus sediment, moves oceanward along the outer portion of the jetty. Also, reflected waves off the jetty and weir structure combine with incident waves to form a short-crested wave field which aids in removal of sediment from the upcoast beach, to various degrees, depending on the structure's angle with respect to the shoreline and the incident wave angle. The effects of groins adjacent to the weir section were examined with regard to providing additional fillet storage and reducing the sediment movement in an oceanward direction along the jetty. Positive results were found for each variation tested.
W86-00152

**BARCELONA HARBOR, NEW YORK, DESIGN FOR HARBOR IMPROVEMENTS: HYDRAULIC MODEL INVESTIGATION,**
Coastal Engineering Research Center, Vicksburg, MS.
R. R. Bottin.
Technical Report CERC-84-3, August 1984. Final Report. 290 p, 6 Fig, 25 Tab, 134 Photos, 28 Plates, 15 Ref, 3 Append.

Descriptors: *Hydraulic models, *Harbors, *Docks, Wave action, Wave height, Barcelona Harbor.

A 1:60-scale (undistorted) hydraulic model of Barcelona Harbor, New York, including approximately 7,000 ft of the New York shoreline and sufficient offshore bathymetry in Lake Erie to permit generation of the required test waves, was used to investigate the design of certain proposed improvements with respect to wave action. Proposed improvements consisted of: (1) rubble-mound breakwater extensions, (2) rubble-mound absorbers installed along the harbor sides of the existing east and west break-waters and the lakeward face of the city dock, (3) rubble-mound spurs installed southerly of the lakeward heads of the existing breakwaters, and (4) a parapet wall installed on the existing west breakwater. Two 60-ft-long wave generators and an Automated Data Acquisition and Control System were utilized in model operation. An optimum improvement plan was selected based on the results of wave-height tests using monochromatic waves and spectral wave tests.
W86-00157

**NAVIGATION CONDITIONS IN VICINITY OF WALTER BOULDIN LOCK AND DAM COOSA RIVER PROJECT: HYDRAULIC MODEL INVESTIGATION,**
Geological Survey, Reston, VA.
C. Myrick, and J. J. Franco.
Technical Report HL-84-11, December 1984. Final Report. 129 p, 16 Fig, 5 Tab, 77 Plates.

Descriptors: *Locks, *Navigation, *Hydraulic models, *Model studies, Models, Navigation canals, Navigation obstructions, Simulation analysis, Design criteria, Surges.

The Walter Bouldin Lock will be the first navigation lock proposed for development of navigation on the Coosa River Waterway. The lock will be located in the left overbank area of Walter Bouldin Dam. Three fixed hydraulic models were used to examine navigation conditions in the reach in areas where difficulties were expected. Results showed that no serious navigation problems should arise in the Jordan Reservoir and in the entrance to the diversion canal. Navigation conditions could be hazardous through the Bouldin reservoir when the pool is below elevation 248.00 ft. due to high velocities and crosscurrents. Tows with sufficient power to overcome the high velocity currents could negotiate the powerhouse tailrace and lower lock approach channel without serious difficulties. Lock emptying and start up of powerhouse units would create surges that would be hazardous to navigation within the lock approach channel and in the reach downstream to below the confluence of the tailrace and the Alabama River. Surges hazardous to navigation could also develop when closing down one or more powerhouse units.
W86-00171

**NAVIGATION CONDITIONS AT MITCHELL LOCK AND DAM, COOSA RIVER, ALABAMA,**
National Oceanic and Atmospheric Administration, Seattle, WA. Pacific Marine Environmental Lab.
C. M. Myrick.
Technical Report HL-84-12, December, 1984. Final Report. 70 p, 14 Fig, 9 Tab, 31 Plates.

Descriptors: *Locks, *Model studies, *Design criteria, *Navigation, Structural models, Models, Planning, Structural engineering, Dams, Hydraulic structures, Gates, Hydraulic gates.

A fixed-bed model reproducing about 4 miles of the Coosa River and adjacent overbank areas to an undistorted scale of 1:120 was used to provide data on navigational conditions with the proposed lock (Mitchell Lock). Results of the study showed that with medium to high flows, navigation conditions at the Highway 22 Bridge would be hazardous for both upbound and downbound tows due to the high velocities and limited width provided through the navigation span with the existing piers and low superstructure. With the first and second lock alignments, navigation conditions were acceptable with the 35,000 cu ft/sec flow only. With the third lock alignment, navigation conditions were acceptable for all flows evenly distributed through the gated dam up to and including the 90,000 cu ft/sec flow. Flows unevenly distributed through the gated dam could cause navigation problems in the lower pool. Navigation conditions would be hazardous for tows in the upper lock approach canal during lock filling or at the end of the lower guard wall when emptying the lock into the lower approach with no riverflow. This problem could be eliminated by a riverflow of 35,000 cu ft/sec or by emptying the lock into the river.
W86-00177

**PROGRAM CRITERIA SPECIFICATIONS DOCUMENT: COMPUTER PROGRAM TWDA FOR DESIGN AND ANALYSIS OF INVERTED-T RETAINING WALLS AND FLOODWALLS,**
Army Engineer Div. Lower Mississippi Valley, Vicksburg, MS.
V. M. Agostinelli, W. A. Price, and C. E. Pace.
February 1981. Final Report. 217 p, 10 Fig, 12 Exhibits.

Descriptors: *Structural engineering, *Soil mechanics, *Computer programs, *Design criteria, *Retaining walls, Walls, Load distribution, Stability analysis, Earth pressure, Soil pressure, Hydrostatic pressure, Seepage, Soil properties, Shear, Friction, Compressive strength, Earthquake engineering, Seismic properties, Water pressure, Reinforced concrete, Concrete, Stress, TWDA program.

This document presents criteria prepared as the basis for developing TWDA (T-wall design/analysis), a computer program for design and analysis of inverted-T cantilever walls founded on earth or rock. These structures can act as floodwalls or retaining walls. The program is a series of design or analysis modules, each performing one specific step. Data are of two types: basic and load case. Stability criteria are the most uncertain and among the most important data used in design of an inverted-T wall. Other criteria are applied pressures (earth, overturning and sliding, hydrostatic, surcharge, and seepage), overturning stability, sliding, bearing pressures, earthquake analysis, and structural design (stress, reinforcing steel, stem loadings).
W86-00193

**CLEVELAND HARBOR, OHIO: DESIGN FOR THE SAFE AND EFFICIENT PASSAGE OF 1,000-FT-LONG VESSELS AT THE WEST (MAIN) ENTRANCE, HYDRAULIC MODEL INVESTIGATION,**
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
R. R. Bottin.
Technical Report HL-83-6, March 1983. Final Report. 346 p, 8 Fig, 34 Tab, 170 Photos, 20 Plates, 21 Ref, 2 Append.

Descriptors: *Breakwaters, *Navigation, *Waves, Cleveland Harbor, Ohio, Lake Erie, Model studies, Hydraulic models, Water currents, Channel improvement, Transportation, Ships.

A 1:100-scale hydraulic model of Cleveland Harbor, Ohio, was used to investigate the effects of proposed improvements on ship maneuverability, wave and current action, and river flow conditions. Proposed changes included removal of portions of the existing breakwater spurs, deepening and widening of the existing channel, installation of additional breakwaters, and modifications of existing arrowhead breakwaters. Results indicated that existing conditions are characterized by rough and turbulent waves during storms, making the west entrance unsafe for 1000-ft long ore carriers. For safe passage of the 100-ft ships in fair weather, the east and west breakwater spurs should be reduced in length by 200 ft and 300 ft, respectively. However, this alteration would increase wave heights in the Lakefront Harbor. The optimum crest elevation of the west arrowhead breakwater should be 14 ft (10 ft if the structure is sealed). The optimum plan for severe weather conditions (thus for all wave conditions) consisted of removal of 300 ft of the existing west spur breakwater and 200 ft of the existing east spur breakwater, 1000-ft parallel extension of the east and west arrowhead breakwaters.
W86-00204

**CHANNEL CONTROL STRUCTURES FOR SOURIS RIVER, MINOT, NORTH DAKOTA: HYDRAULIC MODEL INVESTIGATION,**
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
P. A. Saunders, and J. L. Grace.
Technical Report HL-81-3, April 1981. Final Report. 57 p, 9 Fig, 1 Tab, 17 Photos, 16 Plates.

Descriptors: *Hydraulics, *Erosion control, *Channels, *Gabions, Riprap, Model tests, Hydraulic models, Souris River, North Dakota, Ice, Flow characteristics, Bank stabilization.

Model tests of channel control structures constructed of concrete and gabions were conducted at an undistorted scale ratio of 1:12 to determine the discharge characteristics of the structures, size and extent of riprap required to prevent scour downstream of the structures, effects of ice flowing over the structures, and stability of the gabion structures. The gabion structure was located in a typical section of trapezoidal channel, and a stable gabion configuration was developed by extending the gabions farther up the side slopes and farther downstream of the structure than was indicated in the original design. The concrete structure was placed in an expanded section of trapezoidal channel with riprap protection on the slide slopes and on the channel bottom upstream and downstream of the structure. Model results indicated that the original size and extent of protection could be reduced without endangering the structure. Free and submerged flow discharge characteristics were determined for both types of channel control structures tested, and stability criteria were developed for the gabion structures. (Author)
W86-00209

TECHNIQUE TO OPTIMALLY LOCATE MULTILEVEL INTAKES FOR SELECTIVE WITHDRAWAL STRUCTURES,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
M. S. Dortch, and J. P. Holland.
Technical Report HL-84-9, November 1984. Final Report. 34 p, 11 Fig, 4 Tab, 5 Plates, 8 Ref, Append.

Descriptors: *Hydraulic structures, *Dams, *Reservoirs, *Outlets, *Intakes, *Water quality control, Optimization, Mathematical models, Model studies, Beltzville Dam, Design criteria.

A systematic procedure is given for designing an optimum selective withdrawal intake configuration for a reservoir outlet works. A reservoir thermal simulation model was coupled with a mathematical optimization algorithm to develop the optimal vertical placement of intakes and to minimize the total number of intakes. The simulation/optimization technique was applied to a specific case: the selective withdrawal intake structure at Belzville Dam on the Pohopoco Creek, Pennsylvania. Two mathematical optimization techniques were tested. The cyclic coordinate search with the Golden Section line search proved more suitable than Powell's method.
W86-00213

FLOOD CONTROL MINNESOTA RIVER, MINNESOTA, MANKATO-NORTH MANKATO-LEHILLIER: DESIGN MEMORANDUM NO. 8, PART I (LOCATION STUDY).
Army Engineer District, St. Paul, MN.
Available from the National Technical Information Service, Springfield, VA 22161 as ADA-120868. Main Street Trunk Highway 60 Bridge over the Minnesota River between Mankato and North Mankato. Includes the Draft Supplement to the Final Environmental Impact Statement for Bridge Locations. June 1981. 294 p, 10 Fig, 13 Tab, 5 Append.

Descriptors: *Hydraulic structures, *Environmental effects, *Bridges, *Flood control, Highways, Minnesota River, Mankato, Socal impact, Minnesota.

Flood control works are being constructed on the Minnesota and Blue Earth Rivers, Minnesota, to protect developed portions of Mankato, North Mankato, and Le Hillier from frequent flood damage. This report details the engineering studies for the modification to the Main Street bridge, which must be raised or replaced to an elevation of 30 ft above the existing bridge. The tentative plan would produce adverse neighborhood impacts in Mankato.
W86-00238

WAVE STABILITY STUDY OF RIPRAP-FILLED CELLS: HYDRAULIC MODEL INVESTIGATION,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
D. G. Markle.
Miscellaneous Paper HL-83-2, April 1983. Final Report. 59 p, 43 Fig, 1 Tab, 18 Plates.

Descriptors: *Erosion control, *Soil mechanics, *Riprap, *Wave action, *Bank protection, Bank stabilization, Stream stabilization, Hydraulic models, Model studies, Wave runup.

Both two-dimensional and three-dimensional hydraulic model investigations were conducted to test the stability of a new streambank protection concept when exposed to short-period wave attack. The concept, referred to as 'Riprap-Filled Cells,' consists of containerizing riprap in various sizes of cells. Based on the 1:4-scale (model:prototype) model tests and results for the 'riprap-filled cells' placed on IV-on-2H streambank slopes that are assumed to be stable and impermeable and for angles of wave attack of 90, 60, and 30 degrees, it is concluded that: (a) one-ft-cube cells (full and half-full of 0.6- to 4.6-lb riprap) are stable (no streambank exposure) for 2.0-sec, 1.0- to 1.75-ft, 4.0-sec, 1.0- to 3.0-ft, and 6.0-sec, 1.0- to 2.5-ft nonbreaking waves; (b) rectangular cells (half-full of 0.6- to 4.6-lb riprap) are stable for nonbreaking wave heights up to and including 1.5 ft for wave periods of 2.0 and 6.0 sec. Wave heights exceeding this produce spot exposures of the streambank; (c) rectangular cells (full of 0.6- to 4.6-lb riprap) are stable for 6.0-sec, nonbreaking waves up to and including, 2.0 ft. Wave heights exceeding 2.0 ft produced spot exposures of the streambank; (d) both runup and rundown on all sections tested appear to be functions of wave steepness, relative depth, and angle of wave attack. The angles of wave attack, listed in descending magnitudes of runup and rundown produced, are 60, 90, and 30 degrees. One-ft-cube cells, full of riprap, and rectangular cells, half-full of riprap, show trends of decreasing runup and rundown with increasing values of wave steepness and relative depth. Insufficient data are available for these trends to be well defined for the 1-ft-cube cells, half-full of riprap and the rectangular cells, full of riprap. (Author)
W86-00283

## 8B. Hydraulics

B-JUMPS AT ABRUPT CHANNEL DROPS,
Ecole Polytechnique Federale de Lausanne (Switzerland). Chaire de Constructions Hydrauliques.
W. H. Hager.
Journal of Hydraulic Engineering, Vol. 111, No. 5, p 861-866, May, 1985. 6 Fig, 7 Ref.

Descriptors: *Hydraulic jump, *Pressure distribution, Channel flow, Channels, Fluid mechanics, Stilling basins, Mathematical equations.

Hydraulic jumps are one of the most frequently used energy dissipators. Its simplest form, the palne hydraulic jump occurs in rectangular, prismatic, and almost horizontal channels. Whenever using hydraulic jumps as a kinetic energy dissipator, one has to control carefully its stability under all possible flow conditions, which may be achieved by stilling basins, by which the jump is forced to appear at a particular location. B-jumps in rectangular, prismatic stilling basins consisting of an abrupt drop of the channel bottom are investigated by accounting for the effective pressure distribution and the internal flow process. The traditional approach is modified to yield a more accurate relation for the conjugate flow depths. An equation is proposed which agrees favorably with observations when the pressure distribution at the drop is properly accounted for. (Baker-IVI)
W86-00018

WATER SURFACE AT CHANGE OF CHANNEL CURVATURE,
Alberta Univ., Edmonton. Dept. of Civil Engineering.
P. M. Steffler, N. Rajaratnam, and A. W. Peterson.
Journal of Hydraulic Engineering, Vol. 111, No. 5, p 866-870, May, 1985. 1 Fig, 4 Ref.

Descriptors: *Hydraulic engineering, *Water surface, *Channel flow, *Curves, Froude number, Channels, Model studies, Open channels.

In most work on the problem of flow in curved open channels, the lateral water surface slope has been assumed to be an algebraic function of the local channel curvature. Inspection of experimental water surface profiles indicates that an adjustment length in the order of the channel width is required where the curvature changes abruptly. A simple model is presented for the water surface configuration in the vicinity of an abrupt change in channel curvature taking free surface effects into account. The flow is assumed frictionless and the curvature is assumed mild. A simple expression for the length of such a transition as a function of Froude number has also been presented. The predicted water surface topography was shown to agree reasonably well with a few preliminary experiments. (Baker-IVI)
W86-00019

STORM SEWER OPTIMUM DESIGN,
D. Hoang.
In: Proceedings of Stormwater and Water Quality Model User Group Meeting, January 27-28, 1983, University of Florida, Gainesville. p 272-280, 1 Fig, 3 Tab.

Descriptors: *Storm sewers, *Design criteria, *Models, *Optimization, *Hydraulic models, *Sewer systems, *Cost-benefit analysis, *Hydraulic design, Model studies, Comparison studies, Sewers, Hydrographs, Runoff, Infiltration, Design Flow.

The STORM SEWER OPTIMUM DESIGN is a computer model which provides a fast means for estimating the optimum sewer system features for the least construction costs. The model is composed of a hydrograph computation compartment and design-flow compartment which coordinate to fully utilize the final sewer system. The OPTIMUM DESIGN method uses the real rainfall in selecting design and calculates the costs of sewer components to make cost-benefit analyses of alternative routes easy and effective. The model contains features for the automatic numbering of manholes and sewer lines and for the extension of existing sewer sytems to make storm sewer design more flexible. The OPTIMUM DESIGN method can accommodate users with less extensive engineering backgrounds than usually required of users of the Rational Method for storm sewer design.
W86-00100

POINTE COUPEE PUMPING STATION SUMP AND OUTLET STRUCTURE, UPPER POINTE COUPEE LOOP AREA, LOUISIANA: HYDRAULIC MODEL INVESTIGATION,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
For primary bibliographic entry see Field 8C.
W86-00101

ENERGY LOSSES AT STRAIGHT-FLOW-THROUGH SEWER JUNCTIONS,
National Water Research Inst., Vancouver (British Columbia).
J. Marsalek.
Environment Canada, Canada-Ontario Agreement on Great Lakes Water Quality, Research Report No. 111, 1981. 29 p, 9 Fig, 4 Tab, 13 Ref.

Descriptors: *Energy loss, *Sewer hydraulics, *Sewer systems, *Manholes, *Flow velocity, *Flow characteristics, *Pipe flow, *Hydraulics, Energy dissipation, Mathematical studies, Channel flow, Pipes, Pipelines.

Energy losses at straight-flow-through sewer junctions with free water surface were found to be considerably less than those in fully-pressurized pipe junctions without the free water surface. Mean energy losses observed for open-channel junctions were less than those for the same junc-

tions operating under pressure. There were only small differences in energy losses between square and circular manholes. Energy losses were less in manholes with installed benching. The junction energy loss coefficient was nearly doubled for manholes with pressurized flow and nearly halved for manholes with a benching extending to the pipe crown. In sewers with closely spaced manholes, the overall system capacity may suffer marked energy losses. These may be compensated for by providing additional drops in the pipe invert. Such modifications are particularly important for surcharged sewer systems in which flow velocities and the corresponding junction energy losses may become appreciable. The energy loss coefficients presented in this report can provide data useful in the computerized calculation of pressurized flow.
W86-00103

**HYDRAULICS FOR OPERATORS,**
Michigan Dept. of Public Health, Lansing. Section of Water Supply.
W. E. Brown.
Water Treatment Plant Operations Series, Volume 3, Ann Arbor Science, Ann Arbor, MI. 1981. Edited by V. W. Langworthy. 145 p.

Descriptors: *Hydraulics, *Hydrodynamics, *Flow characteristics, *Fluid mechanics, Orifices, Pipe flow, Channel flow, Flow measurement, Weirs, Manometers, Pumps, Pumping, Reviews.

This text is designed for trainees and personnel involved in water utility operations. Twelve lessons are presented on the flow of water and wastewater through pipes and channels, the use of pumps, and the effects of pressure exerted by water in a constructive or destructive fashion. Subject matter is presented in the simplest manner possible, and each lesson terminates with a list of problems and solutions for commonly encountered calculations or situations in the water utility field. The lessons presented are: hydraulic concepts, pressure, fundamentals of flow, pipe flow with friction loss, compound pipes, minor losses in fluid flow, flow in open channels, flow measurements, pump types and characteristics, and pumping. Lessons on the fundamentals of flow deal with head flow and Bernoulli's equation. Lessons on flow measurements deal with orifices, pipe flow, and Venturi meter, flow rate controls, manometers, weirs, other channel metering devices, and flow from the end of a pipe.
W86-00135

**DIMENSIONS FOR SAFE AND EFFICIENT DEEP-DRAFT NAVIGATION CHANNELS: HYDRAULIC MODEL INVESTIGATION,**
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
H. O. Turner.
Technical Report HL-84-10, December 1984. Final Report. 39 p, 27 Fig, 8 Ref.

Descriptors: *Model studies, *Design criteria, *Channel improvement, *Channel morphology, *Channels, *Navigation, Models, Watercourses, Planning, Telemetry.

Existing criteria for the design of deep-draft channels were evaluated to determine if revisions could be made to channel dimensions. Free-running, remote-controlled model ships at a scale of 1:100 were used to examine deep-draft navigation channel design methods. The tanker class of ships was used in the testing program because of the wide beam and slow response to rudder commands. The model ships were equipped with a video camera and telemetry instrumentation. Performance data concerning rudder angle, shaft rpm, and heading were also recorded and plotted. The straight reach tests were conducted at a depth to draft ratio of 1.2. The channel width dimension was narrowed until an unsafe condition existed. Results of model test for both one-way and two-way traffic showed that only a slight reduction in channel widths (about 10%) could be made. Additional safety factors should be allowed; however, revisions of the design criteria should not be based on the results of this study due to model scale effects and inaccuracies in the facility.
W86-00148

**WEIR JETTY PERFORMANCE: HYDRAULIC AND SEDIMENTARY CONSIDERATIONS, HYDRAULIC MODEL INVESTIGATION,**
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
For primary bibliographic entry see Field 8A.
W86-00152

**BARCELONA HARBOR, NEW YORK, DESIGN FOR HARBOR IMPROVEMENTS: HYDRAULIC MODEL INVESTIGATION,**
Coastal Engineering Research Center, Vicksburg, MS.
For primary bibliographic entry see Field 8A.
W86-00157

**COMPUTER MODELING OF HYDRODYNAMICS AND SOLUTE TRANSPORT IN CANALS AND MARINAS: LITERATURE REVIEW AND GUIDELINES FOR FUTURE DEVELOPMENT,**
National Board of Waters, Helsinki (Finland).
For primary bibliographic entry see Field 5B.
W86-00179

**CLEVELAND HARBOR, OHIO: DESIGN FOR THE SAFE AND EFFICIENT PASSAGE OF 1,000-FT-LONG VESSELS AT THE WEST (MAIN) ENTRANCE, HYDRAULIC MODEL INVESTIGATION,**
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
For primary bibliographic entry see Field 8A.
W86-00204

**MEGEE CREEK PUMPING STATION SIPHON, PIKE COUNTY, ILLINOIS: HYDRAULIC MODEL INVESTIGATION,**
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
R. R. Copeland.
Technical Report HL-82-23, September 1982. Final Report. 73 p, 17 Fig, 6 Tab, 6 Photos, 25 Plates, 15 Ref.

Descriptors: *Hydraulic structures, *Siphons, *Flood control, *Pumping plants, MeGee Creek Pumping Station, Hydraulic models, Model studies, Saxophone siphon, Outlets, Hydraulic jump.

A 1:4.36-scale hydraulic model of the proposed McGee Creek pumping station siphon was used to develop a design with adequate hydraulic performance. The saxophone outlet design was modified to ensure maintenance of the priming seal. Priming times and head losses were measured in the model. Modifications to decrease priming times were tested, including a reduced cross-sectional area at the crown, and air escape vents. The recommended design siphon operated satisfactorily for the entire range of expected tailwaters and discharges. (Author)
W86-00219

**CHANNEL WIDTHS IN BENDS AND STRAIGHT REACHES BETWEEN BENDS FOR PUSH TOWING: HYDRAULIC MODEL INVESTIGATION,**
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
L. J. Shows, and J. J. Franco.
Technical Report HL-82-25, October 1982. Final Report. 38 p, 9 Fig, 4 Photos, 7 Plates.

Descriptors: *Hydraulic structures, *Transportation, *Waterways, *Channel morphology, Navigable waters, Towing, Hydraulic models, Model studies, Shallow water, Ships.

This investigation was concerned with the development of parameters that could be used as a guide in the layout and design of shallow-draft waterways, particularly bends and straight reaches between bends. Results are based largely on model studies using different linear scales and some limited prototype tests. In negotiating a bend or making a turn, tows occupy a greater channel width than in straight reaches. The width of channel required depends on the deflection or drift angle which varies with the size of tow, radius of the bend or turn, length of the bend up to about 90 degrees, alignment and velocity of currents, weather conditions, direction of travel (upstream or downstream), draft of tow with respect to channel depth, alignment and location of the tow when entering the bend, and maneuverability of the tow. If the deflection angle assumed by a tow in negotiating a bend is known, the width of channel required can be computed using one of the equations from this study. Results include curves showing the deflection angle assumed by tows of various sizes in bends of different curvatures with and without currents. Also covered are bends consisting of compound curves, bends with irregular band lines, and lengths of straight reaches required between alternate bends. (Author)
W86-00225

**MISSION BAY HARBOR, CALIFORNIA, DESIGN FOR WAVE AND SURGE PROTECTION AND FLOOD CONTROL: HYDRAULIC MODEL INVESTIGATION,**
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
C. R. Curren.
Technical Report HL-83-17, June 1983. Final Report. 314 p, 12 Fig, 28 Tab, 100 Photos, 72 Plates, 23 Ref, 3 Append.

Descriptors: *Hydraulic structures, *Waves, *Shore protection, *Flood control, *Breakwaters, Tides, Hydraulic models, Model studies, Mission Bay Harbor, San Diego River, California, Harbors, Navigation, Shoals, Jetties, Surges, Water currents, Channels, Wave height.

A 1:100-scale hydraulic model of the Mission Bay Harbor, California, area was used to study proposed structures for improving navigation conditions at the harbor entrance, reducing surges inside the harbor, and eliminating potential flood hazards from a sand plug in the San Diego River flood control channel. Two alternatives were found viable for protecting the harbor from waves and surges. Both involved an offshore 1600-ft breakwater. Tests of the present configuration in the channel showed that upstream flooding occurred at 97,000 cfs, the maximum flood flow, as well as at 49,000 cfs. Several alternatives reduced flooding: reducing the elevation of the sand plug by 6 ft, dredging sections of the sand plug, building a weir into the middle jetty. To prevent formation of the sand plug several methods were also effective: extension of the south jetty, construction of a pilot channel in the sand plug, and a diversion structure on the middle jetty.
W86-00255

**EDGEWATER MARINA, CLEVELAND, OHIO: DESIGN FOR WAVE PROTECTION, HYDRAULIC MODEL INVESTIGATION,**
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
R. R. Bottin, and H. F. Acuff.
Technical Report Hl-83-11, July 1983. Final Report. 79 p, 6 Fig, 6 Tab, 28 Photos, 14 Plates, 11 Ref, Append.

Descriptors: *Hydraulic structures, *Shore protection, *Harbors, *Lakes, Breakwaters, *Waves, Navigation, Storms, Marinas, Cleveland Harbor, Edgewater Marina, Lake Erie, Hydraulic models, Model studies, Lake shores, Protection, Water currents, Wave height.

A 1:100-scale model was used to evaluate planned improvements at Edgewater Marina, Cleveland Harbor, Lake Erie. These improvements were 23 combinations of the following: modifications to the harbor entrance and channel, installation of new breakwaters, modifications to the existing structures, and installation of rubble absorbers in the harbor. Several optimal improvement plans were chosen, and of which should reduce or eliminate hazardous wave-induced currents in the basin during boating season. Optimal plans were chosen

for the following scenarios: (1) new breakwater installed at the entrance and the east breakwater raised to 9.5 ft, (2) absorber installed at the entrance and east breakwater raised to 9.5 ft, (3) existing entrance closed and raised to 9.5 ft, east breakwater raised to 9.5 ft, and new entrance through the west breakwater, and (4) curved portion of the Edgewater breakwater replaced with randomly placed stone and east breakwater raised to 15 ft.
W86-00256

**DESIGN FOR PREVENTION OF BEACH EROSION AT PRESQUE ISLE BEACHES, ERIE, PENNSYLVANIA: HYDRAULIC MODEL INVESTIGATION,**
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
W. C. Seabergh.
Technical Report HL-83-15, June 1983. Final Report. 315 p, 24 Fig, 4 Tab, 194 Plates, 10 Ref.

Descriptors: *Hydraulic structures, *Beaches, *Breakwaters, *Lakes, *Shore protection, Sediment transport, Wave action, Water currents, Groins, Model studies, Hydraulic models, Erosion control, lake shores, Presque Isle, Lake Erie.

Beach erosion at Presque Isle on Lake Erie was studied with a 1:50-scale hydraulic model. Various offshore breakwater plans were tested. Satisfactory results were obtained with 150-ft-long breakwaters with 350-ft spacing, regardless of groin presence or conformation. Tombolo development was dependent on proximity to groins, water level, wave height and period, crown elevation of the structure, distance of the breakwater from the initial shoreline, and sediment supply. Once a tombolo had attached to the breakwater, high water levels and waves overtopping the breakwater were required to erode the tombolo beachline back from the offshore breakwater. The strong longshore currents seen in the baseline tests were replaced by slower eddy-type currents behing the breakwaters. In large wave situations, currents moving lakeward between the breakwaters were diffused. Most sediment was retained shoreward of the line formed by the offshore breakwaters.
W86-00257

**FUNCTIONAL DESIGN OF CONTROL STRUCTURES FOR OREGON INLET, NORTH CAROLINA: HYDRAULIC MODEL INVESTIGATION,**
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
N. W. Hollyfield, J. W. McCoy, and W. C. Seabergh.
Technical Report HL-83-10, June 1983. Final Report. 458 p, 25 Fig, 11 Tab, 15 Photos, 365 Plates, 4 Ref.

Descriptors: *Hydraulic structures, *Breakwaters, *Channels, *Tidal effects, Manteo Bay Project, Oregon Inlet, North Carolina, Hydraulic models, Model studies, Jetties, Inlets, Waterways, Shoals, Navigation.

Control of shoaling and breaking waves in Oregon Inlet in North Carolina's Outer Banks was investigated by model testing. The model for the Manteo Bay Project had a 1:300 horizontal and 1:60 vertical scale. Testing included the study of jetty alignment, length, and spacing and the effects of jetty structures on tidal exchange and on the flow through Bonner Bridge. Steady-state ebb and flood storm surges were reproduced to study the effects of the jetties on these flows. Staged jetty construction tests helped to determine the best construction sequence to limit excessive scour velocities. Movable bed tests provided information on the effects of jetties on channel alignment for both normal tides and during storm surge conditions. A parallel two-jetty arrangement would not negatively impact the tidal exchange, storm surge flows, or flow through Bonner Bridge over the inlet. Spacings of 2500, 3500, and 5000 ft were all suitable. However, the large spacings may permit bifurcation of the entrance channel or a more curvilinear channel.
W86-00269

**WAVE DATA ACQUISITION AND HINDCAST FOR SAGINAW BAY, MICHIGAN,**
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
For primary bibliographic entry see Field 2H.
W86-00282

**BLOOMINGTON SPILLWAY NORTH BRANCH POTOMAC RIVER MARYLAND AND WEST VIRGINIA: HYDRAULIC MODEL INVESTIGATION,**
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
B. P. Fletcher.
Technical Report HL-83-9, June 1983. Final Report. 68 p, 11 Fig, 1 Tab, 8 Photos, 30 Plates.

Descriptors: *Hydraulic structures, *Spillways, *Dams, *Model studies, Hydraulic models, Bloomington Spillway, Potomac River, Gates, Dikes, Tainter gates, Eddies, Water currents, Flow pattern, Overburden, West Virginia, Maryland.

Tests to investigate hydraulic performance of the gated spillway and the intensity of return flow on the downstream side of the saddle dike were conducted using a 1:60-scale model. Flow approaching the spillway was satisfactory for all anticipated flow conditions. Eddies generated immediately upstream from the spillway had no significant effect on hydraulic performance. During controlled releases, no surging of flow at the abutments or tainter gates was observed. Model tests of the exit area were conducted with the overburden fixed and then movable. Tests conducted with the fixed overburden indicated that the maximum spillway flow of 178,000 cfs generated only an insignificant (4-ft depth at toe) amount of return flow toward the downstream toe of the saddle dike. Tests conducted with the movable overburden indicated significant displacement caused by a spillway flow of 10,000 cfs. Flows as great as 178,000 cfs caused additional displacement of overburden. The overburden did not scour upstream to the toe of the dike. Test results indicated that the safety of the saddle dike was not jeopardized by return flow with either the fixed or movable overburden simulated in the model. For any spillway flow condition, overburden material downstream from the spillway was transported through the swale and there was no tendency for a debris dam to form. (Author)
W86-00285

**GRAYS LANDING SPILLWAY AND STILLING BASIN, MONONGAHELA RIVER, PENNSYLVANIA: HYDRAULIC MODEL INVESTIGATION,**
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
E. D. Rothwell, N. R. Oswalt, and S. T. Maynord.
Technical Report HL-81-13, November 1981. Final Report. 78 p, 6 Fig, 8 Tab, 32 Photos, 12 Plates.

Descriptors: *Hydraulics, *Spillways, Stilling basins, *Reservoirs, *Dams, Hydraulic models, Model studies, Grays Landing Spillway, Monongahela River, Pennsylvania, Ice, Baffles, Design criteria, Energy dissipation, Locks, Riprap.

The hydraulic performance of the deeply submerged stilling basin for the Grays Landing spillway was studied on a 1:36-scale section model. The best design was a conventional hydraulic jump type energy dissipator which would perform well for both initial construction of one lock, a 576-ft-wide spillway crest and stilling basin, and the ultimate construction of two locks, a 460-ft-wide spillway crest and stilling basin. This design allowed the baffle blocks to be located farther downstream to prevent the ice from attacking the baffles and stilling basin apron. The recommended downstream riprap protection consisted of a 72-ft length of 30-inch riprap with a maximum stone weight of 1350 pounds, followed by a 108-ft length of 18-inch riprap with a maximum stone weight of 292 pounds.
W86-00304

## 8C. Hydraulic Machinery

**POINTE COUPEE PUMPING STATION SUMP AND OUTLET STRUCTURE, UPPER POINTE COUPEE LOOP AREA, LOUISIANA: HYDRAULIC MODEL INVESTIGATION,**
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
R. R. Copeland.
Technical Report HL-83-3, March 1983. Final Report. 103 p, 20 Fig, 32 Tab, 18 photos, 8 plates.

Descriptors: *Models, *Model studies, *Pumps, *Hydraulic models, *Hydraulic equipment, *Design criteria, *Sumps, *Stilling basins, Hydraulic machinery, Performance evaluation, Pumping plants.

Physical models were used to arrive upon a design that would afford optimum hydraulic performance of the Pointe Coupee pumping station sump and outlet structure. A sump design with umbrellas on the suction bells, converging sidewalls, and horizontal vortex supressor beams gave satisfactory sump performance for pumps with low submergence. The umbrellas significantly reduced surface vortices and pressure fluctuations by spreading the flow entering the suction bell. Converging sidewalls streamlined the flow lines entering the suction bell, thus reducing the swirl and the tendency to form surface vortices. The best location for the vortex suppressor beams was just above the upstream lip of the umbrella. Beams should extend approximately 1 ft into the flow and be about 1 ft apart. A hydraulic jump type stilling basin with baffles and divider walls was also developed. Riprap sizes were determined for the outlet channel downstream from the stilling basin. With these modifications, satisfactory sump performance was obtained even for the adverse approach conditions that occur with single pump operations.
W86-00101

**MEGEE CREEK PUMPING STATION SIPHON, PIKE COUNTY, ILLINOIS: HYDRAULIC MODEL INVESTIGATION,**
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
For primary bibliographic entry see Field 8B.
W86-00219

**FLATIRON AGC INTERIM CONTROLLER-VOLUME IV,**
Bureau of Reclamation, Denver, CO. Engineering and Research Center.
W. B. Gish, T. R. Whittemore, C. A. Lennon, and S. C. Stitt.
REC-ERC-84-6, March 1984. 167 p, 165 Fig, 2 Ref.

Descriptors: *Hydraulic machinery, *Electrical equipment, *Computers, *Control systems, *Automation, Flatiron Automatic Generation Controller, Controllers, Laramie River Power Station, Mt. Elbert Powerplant.

The Flatiron Interim Automatic Generation Controller has been placed in service for the Lower Missouri Western Area Power Administration Control Area. This controller controls the energy generation and transfers in northern Colorado, Wyoming, western Nebraska, western South Dakota, and southern Montana. The four-volume series details the design, construction, maintenance and operation of the master station and the remote stations. This volume contains all the hardware and software drawings for the first three volumes in the series, which document the master station system at the Dispatch Center, the Laramie River Power Station RTU, and at Mt. Elbert Powerplant RTU.
W86-00223

**BARKLEY DAM SPILLWAY TAINTER GATE AND EMERGENCY BULKHEADS, CUMBERLAND RIVER, KENTUCKY: HYDRAULIC MODEL INVESTIGATION,**
Army Engineer Waterways Experiment Station,

Vicksburg, MS. Hydraulics Lab.
J. E. Hite, and G. A. Pickering.
Technical Report HL-83-12, August 1983. Final Report. 77 p, 9 Fig, 8 Tab, 12 Photos, 29 Plates.

Descriptors: *Hydraulic structures, *Dams, *Gates, *Spillways, Tainter gates, Spillway gates, Barkley Dam, Cumberland River, Kentucky, Locks, Navigation, Reservoirs, Model studies, Flow pattern, Stilling basins, Piers, Bulkhead gates.

Tests were conducted on 1:15- and 1:50-scale models to determine the cause of and to make modifications for eliminating tainter gate bouncing experienced under certain flow conditions at Barkley Dam. The 1:15-scale model determined the flow conditions that caused the bouncing, and the hydraulic loads and load variations acting on the gate during this occurrence. Hoist load fluctuations in excess of 140 kips were measured. The bottom of the tainter gate was modified to various configurations in an effort to alter the flow patterns causing the bouncing, but these modifications were relatively ineffective in reducing the hoist loads. A 1:50-scale model was incorporated into the study to determine the effect of the downstream spillway piers and the stilling basin on the flow conditions. Test results indicated that increasing the length of the spillway piers by 20 ft downstream reduced the surging of flow assiociated with the bouncing. A minimum top elevation of these extended piers was determined to be 345.0. The hoist loads were then measured with the piers placed in the 1:15-scale model. The maximum hoist load fluctuation was reduced by over 100 kips from 140 kips with the original design to 40 kips with the piers extended. The 1:15-scale model was also used to determine the hydraulic loads that occur as the emergency bulkheads are lowered under flowing water conditions. The bulkhead tests revealed that the loads on the hoist due to hydraulic forces were not extreme for heads on the gate still of 21, 29, and 34 ft as long as the bulkhead was lowered at the prototype hoisting speed of 4 to 6 ft/min. Unstable loads were encountered at heads of 29 and 34 ft on the gate sill when the bulkhead was held at stationary position above the crest with high tailwater conditions. (Author)
W86-00284

## 8D. Soil Mechanics

**PROGRAM CRITERIA SPECIFICATIONS DOCUMENT: COMPUTER PROGRAM TWDA FOR DESIGN AND ANALYSIS OF INVERTED-T RETAINING WALLS AND FLOODWALLS,**
Army Engineer Div. Lower Mississippi Valley, Vicksburg, MS.
For primary bibliographic entry see Field 8A.
W86-00193

**CHANNEL CONTROL STRUCTURES FOR SOURIS RIVER, MINOT, NORTH DAKOTA: HYDRAULIC MODEL INVESTIGATION,**
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
For primary bibliographic entry see Field 8A.
W86-00209

**LIST OF SOILS, SOIL-STRUCTURE INTERACTION AND OTHER RELATED COMPUTER PROGRAMS AVAILABLE FOR LMVD ENGINEERS,**
Army Engineer Waterways Experiment Station, Vicksburg, MS. Automatic Data Processing Center.
N. Radhakrishnana, and P. K. Senter.
Technical Report K-81-1, May 1981. Final Report. 146 p.

Descriptors: *Soil mechanics, *Computer programs, *Hydraulic structures, *Earthworks, T-walls, Slope stability, Retaining walls, Piles, Seepage, Stress, Structural settlement, Piezometers, Measuring instruments, Surveying instruments, Data processing, Plotting, Finite difference methods, Earthquakes, Mississippi River Valley.

This report presents a list of soils, soil-structure interaction, and other related computer programs available for engineers of the Lower Mississippi Valley Division. Programs for use in the following subject areas are listed: T-walls; slope stability; piles, sheet piles, and cells; seepage; stress computation, settlement, and consolidation; piezometer data; instrumentation and laboratory data; plotting programs; finite element and finite difference methods; earthquakes and dynamics; and others. Also included are abstracts of some of the listed programs. (Author)
W86-00262

**WAVE STABILITY STUDY OF RIPRAP-FILLED CELLS: HYDRAULIC MODEL INVESTIGATION,**
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
For primary bibliographic entry see Field 8A.
W86-00283

## 8E. Rock Mechanics and Geology

**SAND RESOURCES AND GEOLOGICAL CHARACTER OF LONG ISLAND SOUND,**
Coastal Engineering Research Center, Fort Belvoir, VA.
S. J. Williams.
Technical Paper No. 81-3, May 1981. 65 p, 27 Fig, 5 Tab, 54 Ref, 2 Append. Project No. D31665.

Descriptors: *Shoals, *Beaches, *Shore protection, *Sediments, Marine sediments, Sand, Gravel, Long Island Sound, Connecticut, Dredging, Bottom sediments, Geology, Marine geology, Continental shelf, Erosion.

Seismic profiles and vibratory cores were used to determine the geologic character of Long Island Sound. Fourteen isolated shoal features were identified as potential sources of beach fill sand and construction aggregate. About 189 million cu m of sand and gravel was estimated to be in water depths not exceeding 20 meters. Fifteen Connecticut beaches needing beach nourishment now and in the future were identified. Many parks and beaches on Long Island's north shore also may benefit from beach fill.
W86-00205

## 8F. Concrete

**ENGINEERING CONDITION SURVEY OF CONCRETE IN SERVICE,**
Army Engineer Waterways Experiment Station, Vicksburg, MS. Structures Lab.
R. L. Stowe, and H. T. Thornton.
Technical Report REMR-CS-1, September 1984. Final Report. 109 p, 33 Fig, 69 Ref, 1 Append.

Descriptors: *Concrete technology, *Surveys, *Concrete testing, Evaluation, Structural engineering, Materials testing, Safety, Standards, Concrete construction, Rehabilitation.

Civil works structures must be continually evaluated for structural safety, stability, and operational adequacy. The overall objective of the investigation documented in this report is to develop information essential to the continued safety of concrete used in civil works structures such as flood control and multipurpose dams, navigation locks and dams, powerhouses and appurtenant structures, floodwalls, pumping stations, and similar structures. Specific objectives include (a) the development and evaluation of materials and techniques for repair and rehabilitation of civil works structures, (b) the development of engineering guidance to evaluate and monitor safety of structures, and (c) the development of design and construction methods for rehabilitating older structures to comply with current structural design criteria. A condition survey of a civil works structure includes a comprehensive review of the design of the structure, construction techniques and materials, and operational maintenance history. Information is obtained from available engineering data on the structure as well as on-site investigations. Data are analyzed and an evaluation report is written which includes conclusions and/or repair recommendations. This report summarizes pertinent inspection procedures and methods of evaluation used by the Corps of Engineers in evaluating concrete civil works structures. Methods of evaluation include experience gained at the Waterways Experiment Station. Techniques are presented which have a potential for ascertaining the extent and cause of inadequacies in concrete structures. (Author)
W86-00161

## 8G. Materials

**SHORE STABILIZATION WITH SALT MARSH VEGETATION,**
Coastal Engineering Research Center, Fort Belvoir, VA.
P. L. Knutson, and W. W. Woodhouse.
Special Report No. 9, January 1983. 95 p, 38 Fig, 4 Tab, 94 Ref. Project No. D31234.

Descriptors: *Erosion control, *Estuaries, *Shore protection, *Marshes, *Vegetation, Fertilizers, Salt marshes, Wetland, Waves, Soil types, Sediments, Salinity, Particle size, Tidal marshes, Wind waves, Cordgrass, Spartina, Sedges, Rushes, Reeds, Mangrove, Environmental effects, Hairgrass.

Comprehensive guidelines are given on the use of marsh plants to control shore erosion from wind waves and tidal currents. Background information includes the role of marsh plants in erosion control, description of the natural coastal marshes by region, and the concept of encouraging marsh establishment to control shore erosion. Planting success depends on several factors. Soil type (cohesive or sandy) often dictates the choice of planting and fertilizer requirements. Some plants tolerate salinity up to the strength of sea water. Most marsh plants are adapted to anaerobic conditions. Exposure to direct sunlight must be assured by clearing woody vegetation 3-5 meters landward. The minimum planting width is about 6 meters. Sediment is beneficial to plantings. An evaluation form for evaluating a site for potential planting success uses shore characteristics (average and longest fetch, shoreline geometry, and sediment grain size). Smooth cordgrass (Spartina alterniflora) is suggested for the Atlantic and Gulf coasts; Pacific cordgrass (Spartina foliosa) for the southern Pacific coast; and Lyngbye's sedge (Carex lyngbyei) and tufted hairgrass (Deschampsia aespitosa) for the northern Pacific coast. Plant materials, available as sprigs, pot-grown seedlings, and plugs, can be planted by hand, power-driven auger, or machine. Fertilizers and application rates are given. Detailed planting specifications are described for a variety of plant species. Cost comparisons of erosion control methods and the potential benefits and disadvantages are summarized.
W86-00189

**MODIFICATION OF BELL CANYON TEST (BCT) 1-FF GROUT,**
Army Engineer Waterways Experiment Station, Vicksburg, MS. Structures Lab.
A. D. Buck, J. E. Rhoderick, J. P. Burkes, K. Mather, and R. E. Reinhold.
Miscellaneous Paper SL-83-18, Report No. SAND 83-7097, September 1983. Final Report. 53 p, 24 Fig, 7 Tab, 6 Ref, 2 Append.

Descriptors: *Water quality control, *Grouting, *Water pollution prevention, *Radioactive waste disposal, Waste disposal, Cements, Bell Canyon, Boreholes, Fly ash, Silica fume, Physical properties, Chemical properties.

Bell Canyon Test (BCT) 1-FF grout was developed as a candidate material for use in repository sealing applications and was actually used in two field tests in New Mexico. This grout and modifications of it were made in the laboratory and tested or examined for workability, compressive strength, restrained expansion, permeability, phase composition, and microstructure. Most of these were done to an age of one year. Compressive

strength and expansion data were determined beyond this age (960 days). Modifications included use of three other cements, two other fly ashes, a silica fume, different water contents, and different amounts of expansive additive (plaster). Each cement and mineral admixture was characterized by conventional chemical and physical tests as well as by X-ray diffraction examination. In general, the results indicated that the modifications to the basic BCT-1-FF grout produced other grouts that were as good as it. An exception to this was the grout mixture (M-8-C) made with shrinkage compensating expansive cement; it had an excessive flow time ( > 20 sec). Another grout mixture (M-9-C) also had excessive flowtime and lower strength. It was thought that these problems could be solved with more modification to these two mixtures. (Author)
W86-00248

PREVENTATIVE MEASURES TO LIMIT STRESS CORROSION CRACKING IN PRESTRESSED CONCRETE,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Structures Lab.
E. F. O'Neil.
Miscellaneous Paper SL-83-14, September 1983. Final Report. 15 p, 4 Fig, 8 Ref.

Descriptors: *Hydraulic structure, *Corrosion control, *Construction materials, *Concrete, *Steel, Coatings, Wires, Polymers, Stress, Cement, Metals, Grouting, Aggregates.

Preventive measures to minimize stress corrosion cracking of prestressed steel are reviewed. Although the mechanisms causing this type of corrosion are little understood, several actions are helpful. Steel properties may be modified to reduce the tendency to corrode. Techniques to improve stress corrosion cracking are proper stress relieving of cold-drawn wire, new methods of quenching and tempering, decarbonizing the surface of the steel, shot peening, and lower final stress levels. Any method that can exclude corrosive gases and liquids also minimizes stress corrosion cracking. Factors in this category are a dense, low-permeability concrete (proper water-cement ratio), good concrete workability, coarse aggregate material, proper vibration in compacting concrete, and longer cure time for concrete. Grouted prestressing systems can be designed with a suitable conduit and grout composition and application. Other methods of protecting steel wires are galvanization, plastic coatings, and polymer impregnated in the pore structure of the concrete.
W86-00249

# 10. SCIENTIFIC AND TECHNICAL INFORMATION

## 10C. Secondary Publication And Distribution

IMPACT OF WATER LEVEL CHANGES ON WOODY RIPARIAN AND WETLAND COMMUNITIES; VOLUME X: INDEX AND ADDENDUM TO VOLUMES I-VIII,
Washington Univ., Seattle. Coll. of Forest Resources.
For primary bibliographic entry see Field 2I.
W86-00254

ANNOTATED BIBLIOGRAPHY ON NORTHERN ENVIRONMENTAL ENGINEERING, 1978-1979,
Environmental Protection Service, Ottawa (Ontario). Water Pollution Control Directorate.
B. C. Armstrong.
EPS 3-WP-81-4, July 1981. 100 p.

Descriptors: *Bibliographies, *Wastewater treatment, *Water treatment, *Cold regions, *Arctic, *Environmental engineering, Polar regions, Ice, Dams, Construction, Industrial wastes, Water pollution.

An annotated bibliography on environmental engineering in northern regions is presented with key words and alphabetical subject index. This biennial edition covers the literature from 1978 and 1979. Among the many subjects are wastewater collection and treatment, construction, dams, water treatment and distribution, environmental impact studies, freeze protection, ice growth, industrial wastes, soils, underground utilities, water pollution, and water supply.
W86-00289

## 10F. Preparation Of Reviews

MICROBIOLOGICAL WATER QUALITY OF IMPOUNDMENTS: A LITERATURE REVIEW,
Texas Univ. at Dallas, Richardson. Graduate Program in Environmental Sciences.
For primary bibliographic entry see Field 5A.
W86-00185

Preparation Of Reviews—Group 10C

[illegible]

## 10. SCIENTIFIC AND TECHNICAL INFORMATION

### 10D. Secondary Publication And Distribution

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